

09/913778

Figure 1

Publication	Specified Reactor	Described Control Method	Post-dep. Annealing Treatment (°C)
Valette S., 1987	Unknown	P doping	Not specified
Valette S., 1988	Unknown	P doping	400°C
Grand G., 1990	Unknown	P doping	1000°C
Liu K., 1995	Unknown	Content in Si, P	Not specified
Ojha S., 1998	Unknown	Ge, B, or P doping	Not specified
Canning J., 1998	Unknown	Ge doping	Not specified
Bulla D., 1998	TEOS	TEOS	Not specified
Johnson C., 1998	SiH₄ + O₂	Si ion Implantation	400°C
Boswell R. W., 1997	SiH ₄ + O ₂	SiH ₄ /O ₂ flow ratio	1000°C
Bazylenko M. V., 1995	SiH ₄ + O ₂ + CF ₄	(SiH ₄ +O ₂)/CF ₄ flow ratio	Not specified
Bazylenko M. V., 1996	SiH ₄ + O ₂ + CF ₄	(SiH ₄ +O ₂)/CF ₄ flow ratio	1000°C
Durandet A., 1996	SiH₄ + O₂ + CF₄	SiH₄/O₂/CF₄ flow ratio	100°C
Kapser K., 1991	SiH ₄ + N ₂ O	SiH ₄ /N ₂ O flow ratio	1060°C
Lai Q., 1992	SiH ₄ + N ₂ O	SiH ₄ /N ₂ O flow ratio	1100°C
Lai Q., 1993	SiH ₄ + N ₂ O	SiH ₄ /N ₂ O flow ratio	1100°C
Pereyra I., 1997	SiH₄ + N₂O	SiH₄/N₂O flow ratio	400°C
Alayo M., 1998	SiH ₄ + N ₂ O	SiH ₄ /N ₂ O flow ratio	1000°C
Kenyon T., 1997	SiH ₄ + N ₂ O + Ar	SiH ₄ /N ₂ O/Ar flow ratio	1000°C
Lam D. K. W., 1984	SiH ₄ + N ₂ O + NH ₃	SiH ₄ /N ₂ O/NH ₃ flow ratio	Not specified
Bruno F., 1991	SiH ₄ + N ₂ O + NH ₃	SiH ₄ /N ₂ O/NH ₃ flow ratio	1100°C
Yokohama S., 1995	SiH ₄ + N ₂ O + NH ₃	SiH ₄ /N ₂ O/NH ₃ flow ratio	Not specified
Agnihotri O. P., 1997	SiH₄ + N₂O + NH₃	SiH₄/N₂O/NH₃ flow ratio	700-900°C
Germann R., 1999	SiH ₄ + N ₂ O + NH ₃	Unknown	1100°C
Offrein B., 1999	SiH ₄ + N ₂ O + NH ₃	Unknown	1150°C
Hoffmann M., 1995	SiH ₄ + N ₂ O + NH ₃ + Ar	SiH ₄ /N ₂ O/NH ₃ /Ar flow ratio	Not specified
Hoffmann M., 1997	SiH ₄ + N ₂ O + NH ₃ + Ar	SiH ₄ /N ₂ O/NH ₃ /Ar flow ratio	Not specified
Tu Y., 1995	SiH ₄ + N ₂ O + NH ₃ + N ₂	N ₂ O/(N ₂ O + NH ₃) flow ratio	1050°C
Poenar D., 1997	SiH ₄ + N ₂ O + NH ₃ + N ₂	SiH ₄ /N ₂ O/NH ₃ /N ₂ flow ratio	850°C
Ridder R., 1998	SiH ₄ + N ₂ O + NH ₃ + N ₂	SiH ₄ /N ₂ O/NH ₃ /Ar flow ratio	1100°C
Worhoff K., 1999	SiH ₄ + N ₂ O + NH ₃ + N ₂	SiH ₄ /N ₂ O/NH ₃ /N ₂ flow ratio	1150°C
Bulat E.S., 1993	SiH₄ + N₂O + N₂ + O₂ + He + CF₄	SiH₄/(N₂O/N₂)/ O₂/CF₄ flow ratio	425°C
This Patent Application	SiH₄ + N₂O + PH₃ + N₂	Patented Pending Method	650°C

Figure 2

FTIR	HO-H	Si-O-H	Si-N-H	Si-N	Si-H	Si=O	N=N	Si-O-Si	Si-O-Si	Si-ON	Si-OH	Si-O-Si	Si-O-Si	
1st mode (μm)	Min	3550	3470	3380	3300	2210	1800	1530	1080	1000	910	860	740	410
	Ave	3650	3510	3420	3380	2260	1875	1555	1180	1080	950	885	810	460
	Max	3750	3550	3460	3460	2310	1950	1580	1280	1160	990	910	880	510
2nd mode (μm)	Min	2.817	2.882	2.959	3.030	4.525	5.556	6.536	9.259	10.000	10.989	11.628	13.514	24.390
	Ave	2.740	2.849	2.924	2.959	4.425	5.333	6.431	8.475	9.259	10.526	11.299	12.346	21.739
	Max	2.667	2.817	2.890	2.890	4.329	5.128	6.329	7.813	8.621	10.101	10.989	11.364	19.608
3rd mode (μm)	Min	1.408	1.441	1.479	1.515	2.262	2.778	3.268	4.630	5.000	5.495	5.814	6.757	12.195
	Ave	1.370	1.425	1.462	1.479	2.212	2.667	3.215	4.237	4.630	5.263	5.650	6.173	10.870
	Max	1.333	1.408	1.445	1.445	2.165	2.564	3.165	3.906	4.310	5.051	5.495	5.682	9.804
4th mode (μm)	Min	0.939	0.961	0.986	1.010	1.508	1.852	2.179	3.086	3.333	3.663	3.876	4.505	8.130
	Ave	0.913	0.950	0.975	0.986	1.475	1.778	2.144	2.825	3.086	3.509	3.766	4.115	7.246
	Max	0.889	0.939	0.963	0.963	1.443	1.709	2.110	2.604	2.874	3.367	3.663	3.788	6.536
5th mode (μm)	Min	0.704	0.720	0.740	0.758	1.131	1.389	1.634	2.315	2.500	2.747	2.907	3.378	6.098
	Ave	0.685	0.712	0.731	0.740	1.106	1.333	1.608	2.119	2.315	2.632	2.825	3.086	5.435
	Max	0.667	0.704	0.723	0.723	1.082	1.282	1.582	1.953	2.155	2.525	2.747	2.841	4.902
6th mode (μm)	Min	0.563	0.576	0.592	0.606	0.905	1.111	1.307	1.852	2.000	2.198	2.326	2.703	4.878
	Ave	0.548	0.570	0.585	0.592	0.885	1.067	1.286	1.695	1.852	2.105	2.260	2.469	4.348
	Max	0.533	0.563	0.578	0.578	0.866	1.026	1.266	1.563	1.724	2.020	2.198	2.273	3.922
7th mode (μm)	Min	0.469	0.480	0.493	0.505	0.754	0.926	1.089	1.543	1.667	1.832	1.938	2.252	4.065
	Ave	0.457	0.475	0.487	0.493	0.737	0.889	1.072	1.412	1.543	1.754	1.883	2.058	3.623
	Max	0.444	0.469	0.482	0.482	0.722	0.855	1.055	1.302	1.437	1.684	1.832	1.894	3.268
8th mode (μm)	Min	0.402	0.412	0.423	0.433	0.646	0.794	0.934	1.323	1.429	1.570	1.661	1.931	3.484
	Ave	0.391	0.407	0.418	0.423	0.632	0.762	0.919	1.211	1.323	1.504	1.614	1.764	3.106
	Max	0.381	0.402	0.413	0.413	0.618	0.733	0.904	1.116	1.232	1.443	1.570	1.623	2.801
	Min	0.352	0.360	0.370	0.379	0.566	0.694	0.817	1.157	1.250	1.374	1.453	1.689	3.049
	Ave	0.342	0.356	0.365	0.370	0.553	0.667	0.804	1.059	1.157	1.316	1.412	1.543	2.717
	Max	0.333	0.352	0.361	0.361	0.541	0.641	0.791	0.977	1.078	1.263	1.374	1.420	2.451

Figure 3a

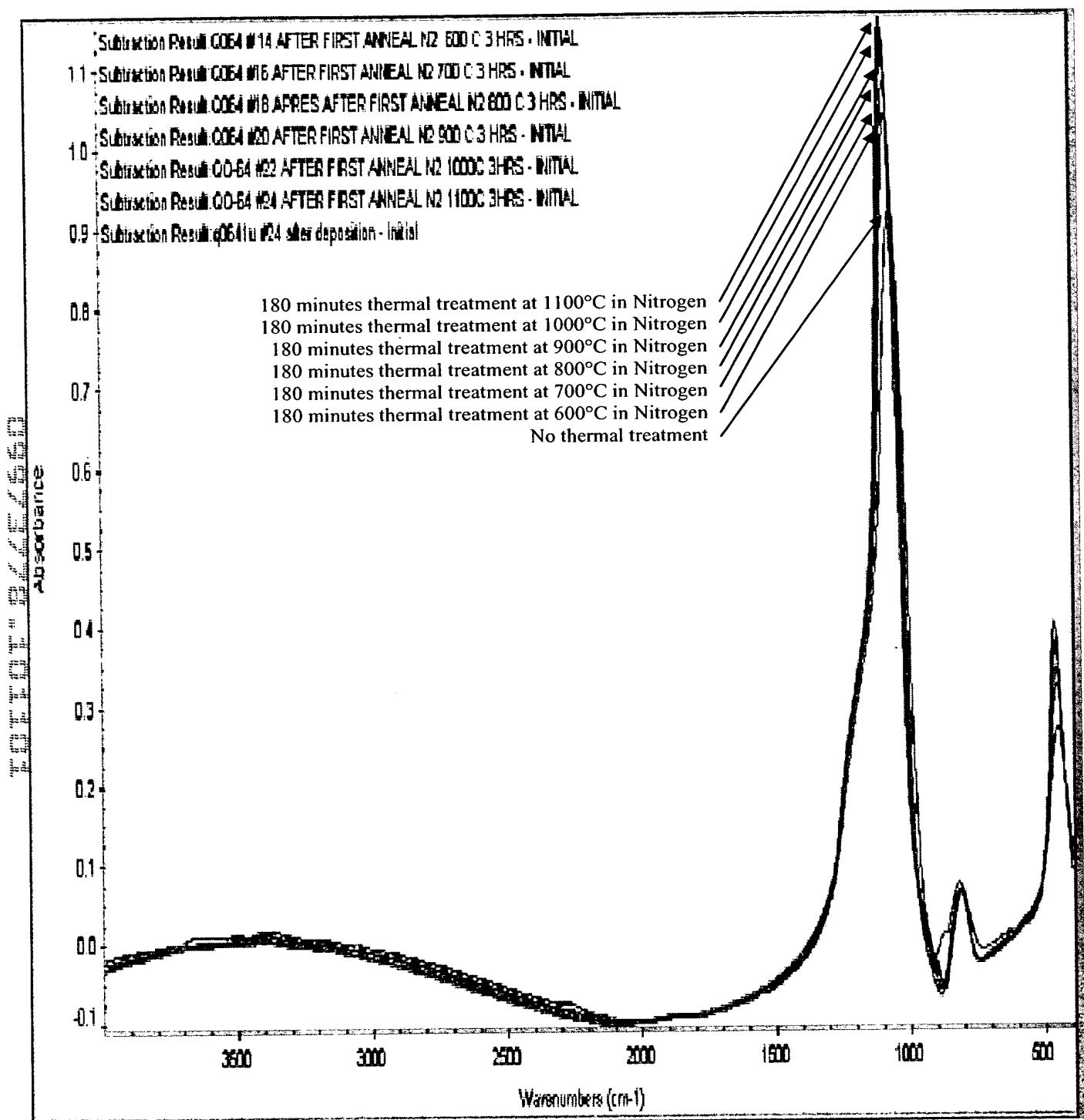


Figure 3b

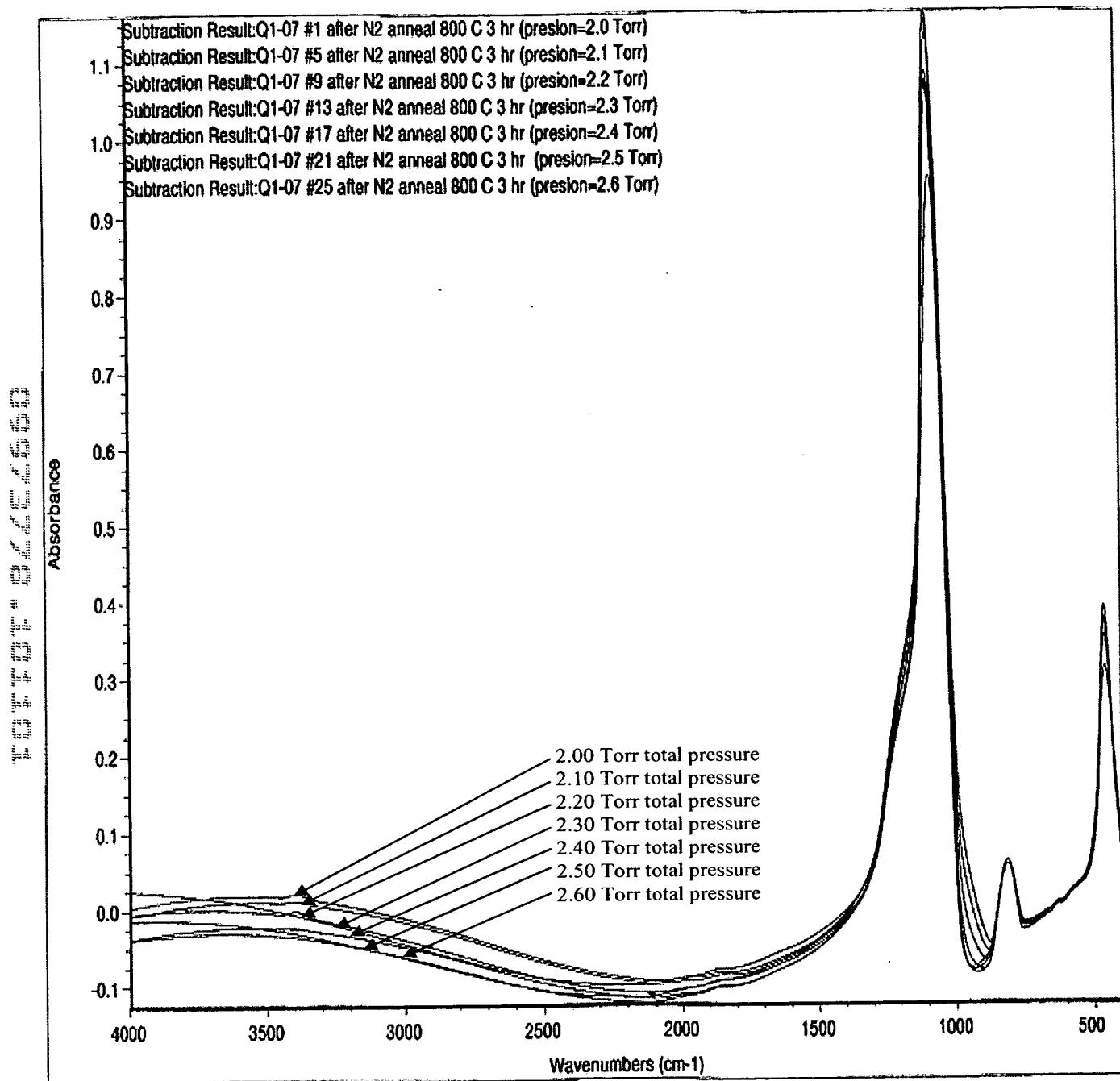


Figure 3c

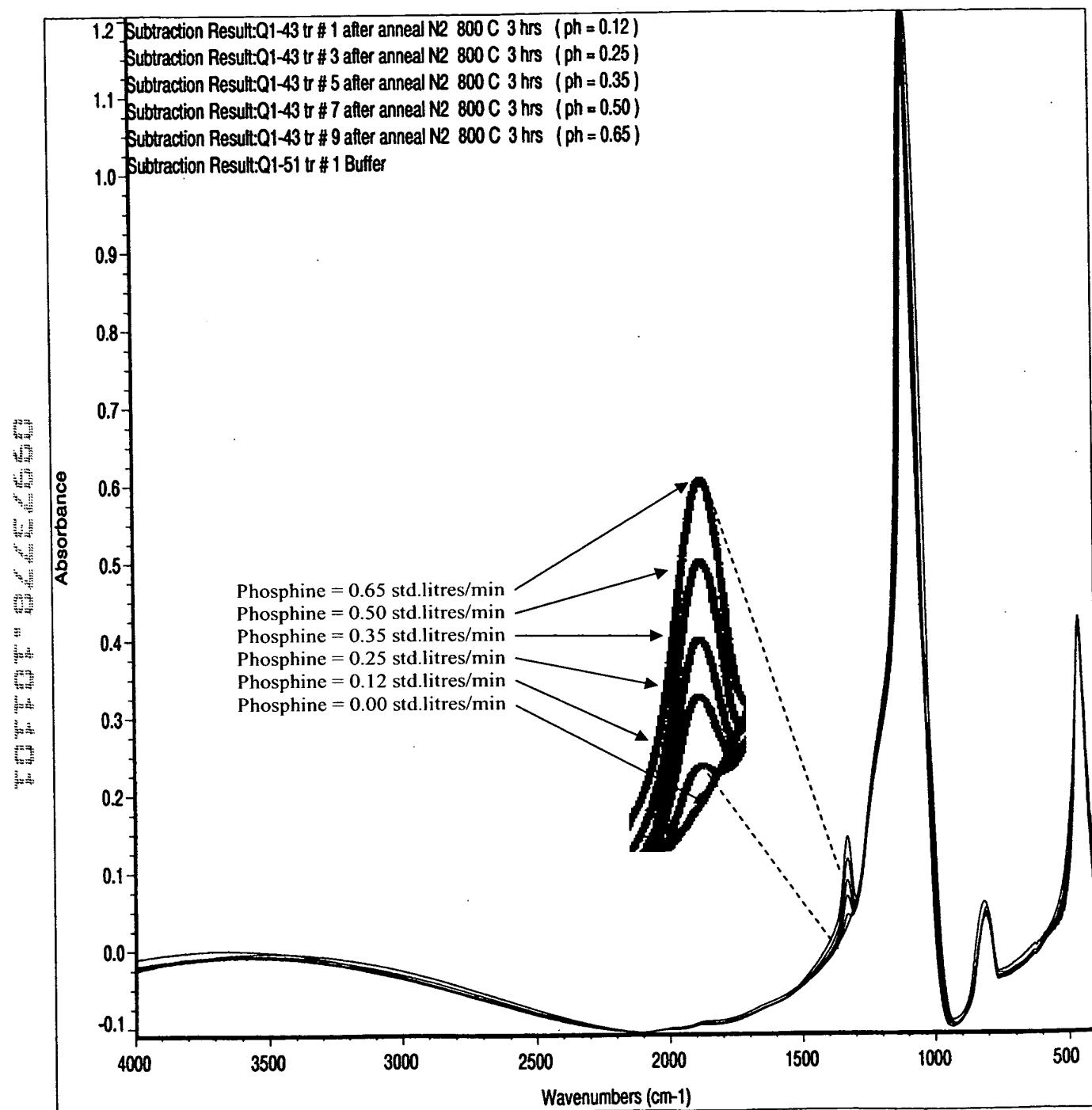


Figure 3d

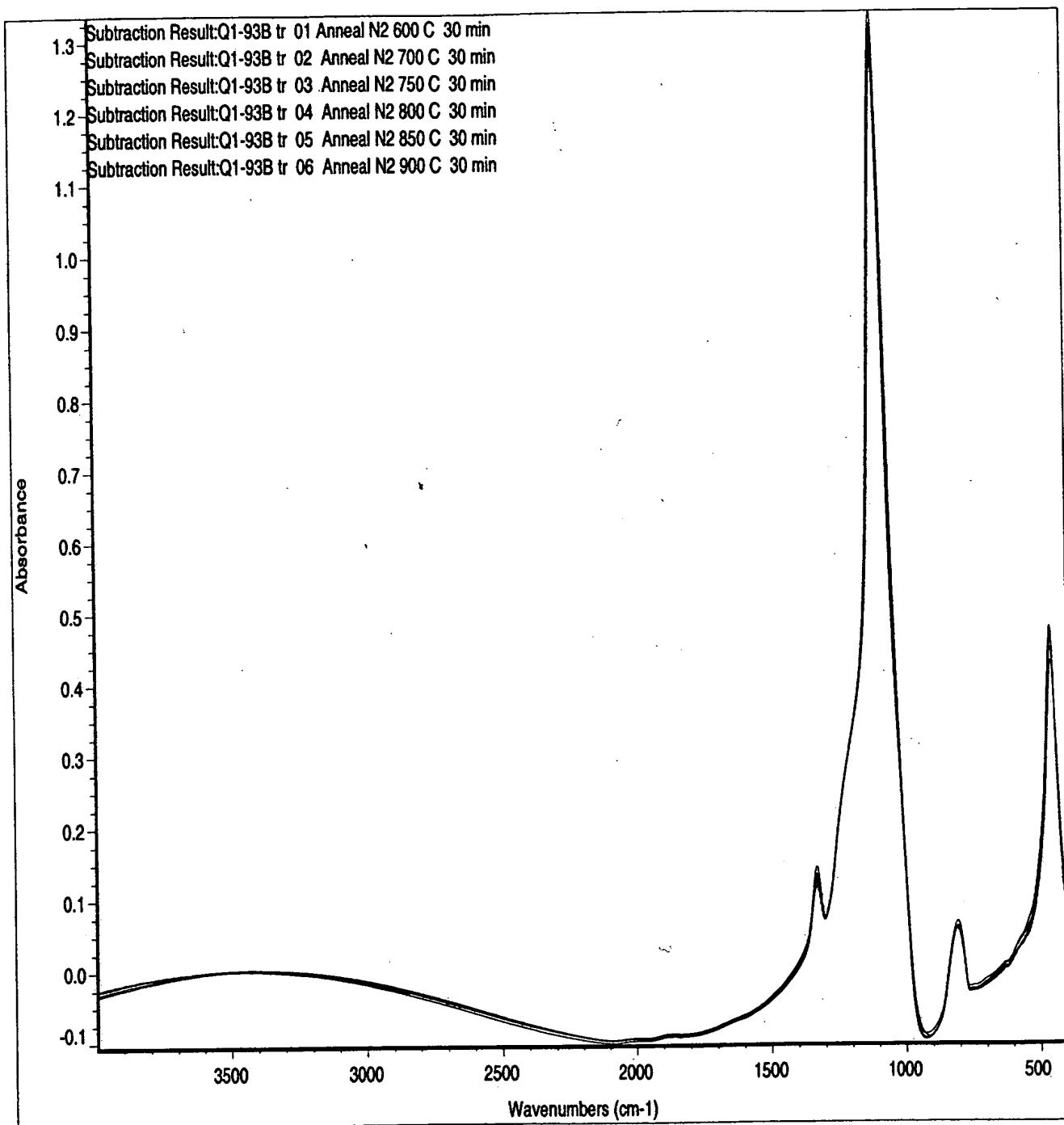


Figure 4a

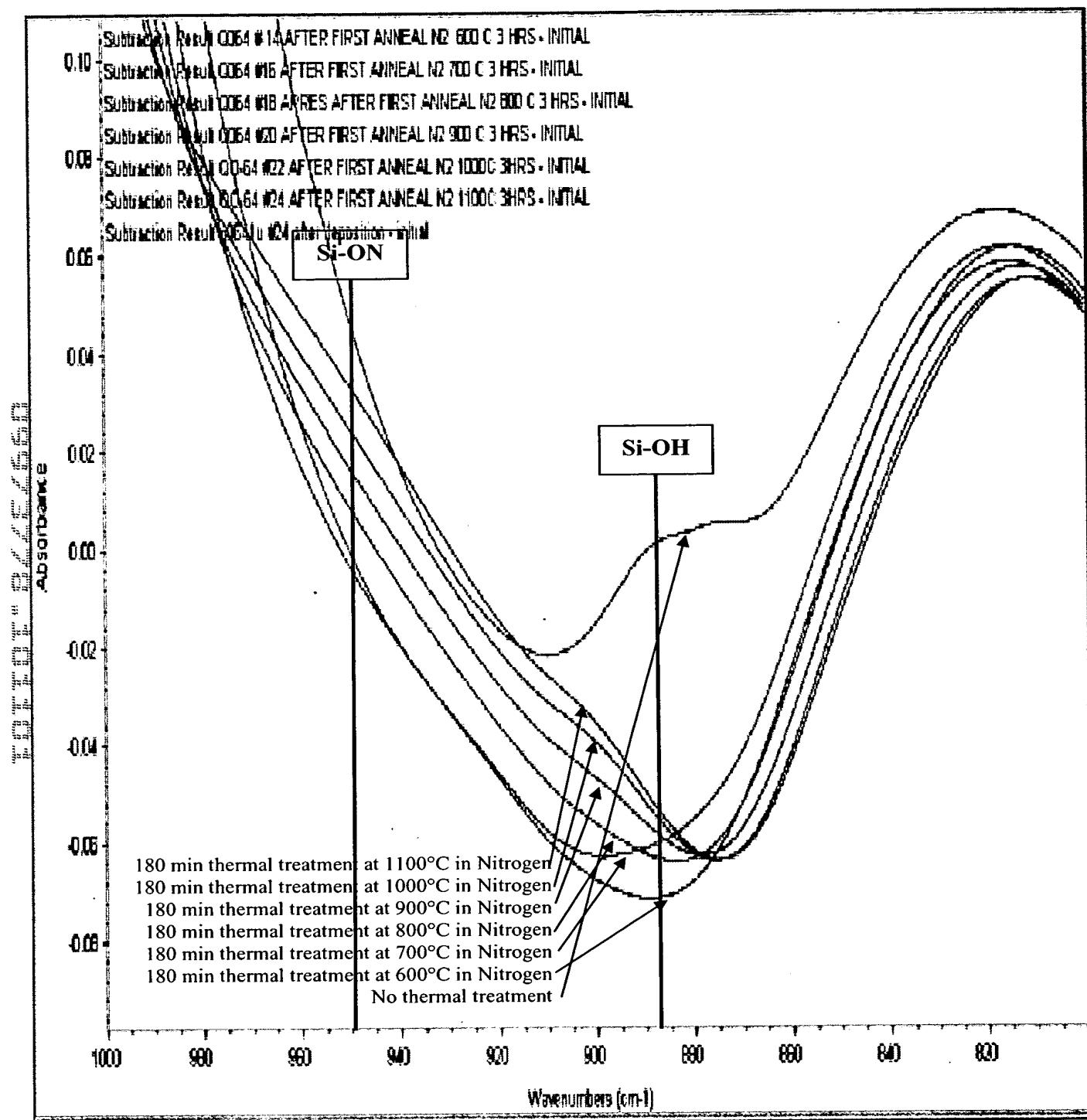


Figure 4b

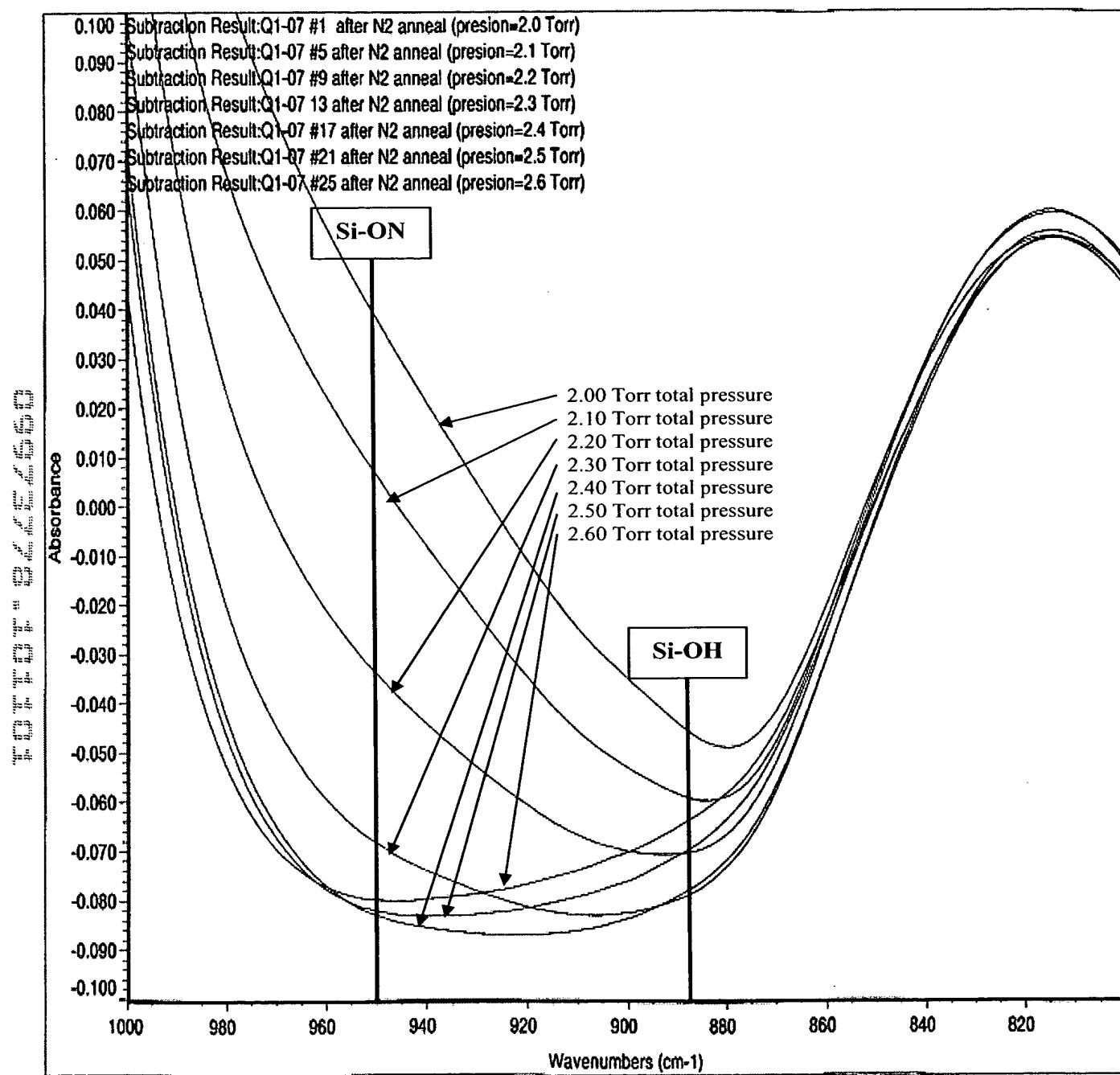


Figure 4c

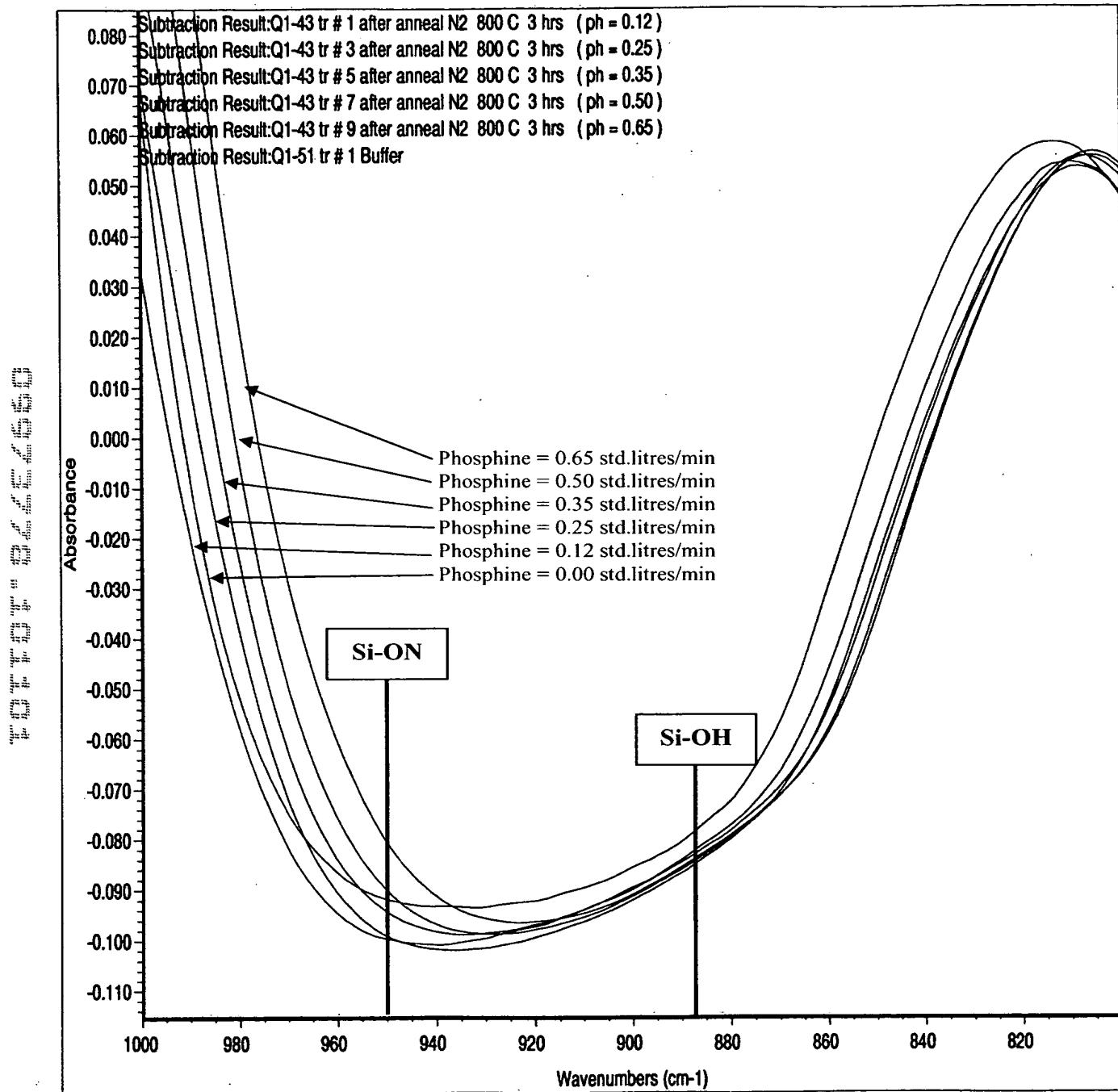


Figure 4d

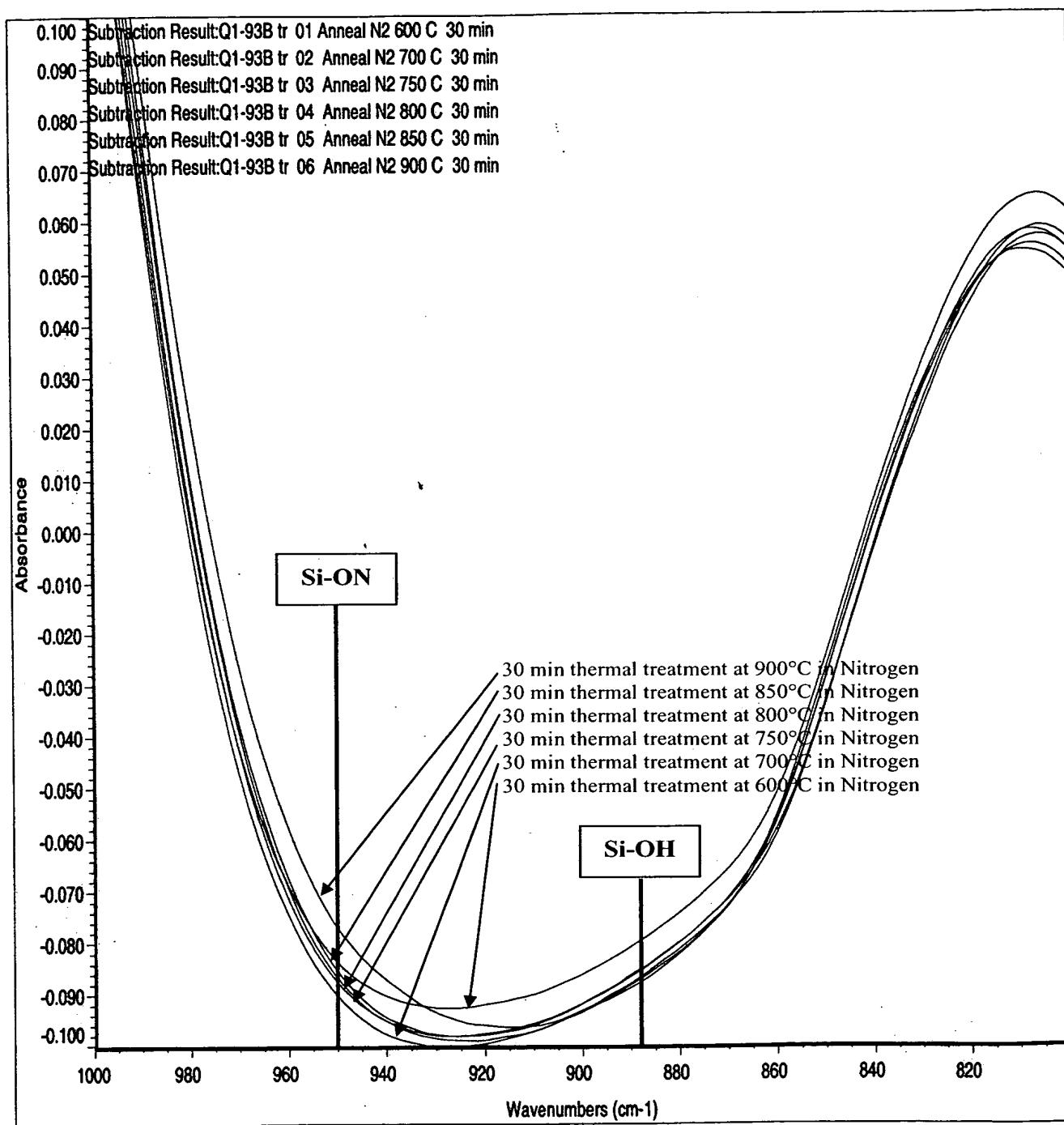


Figure 5c

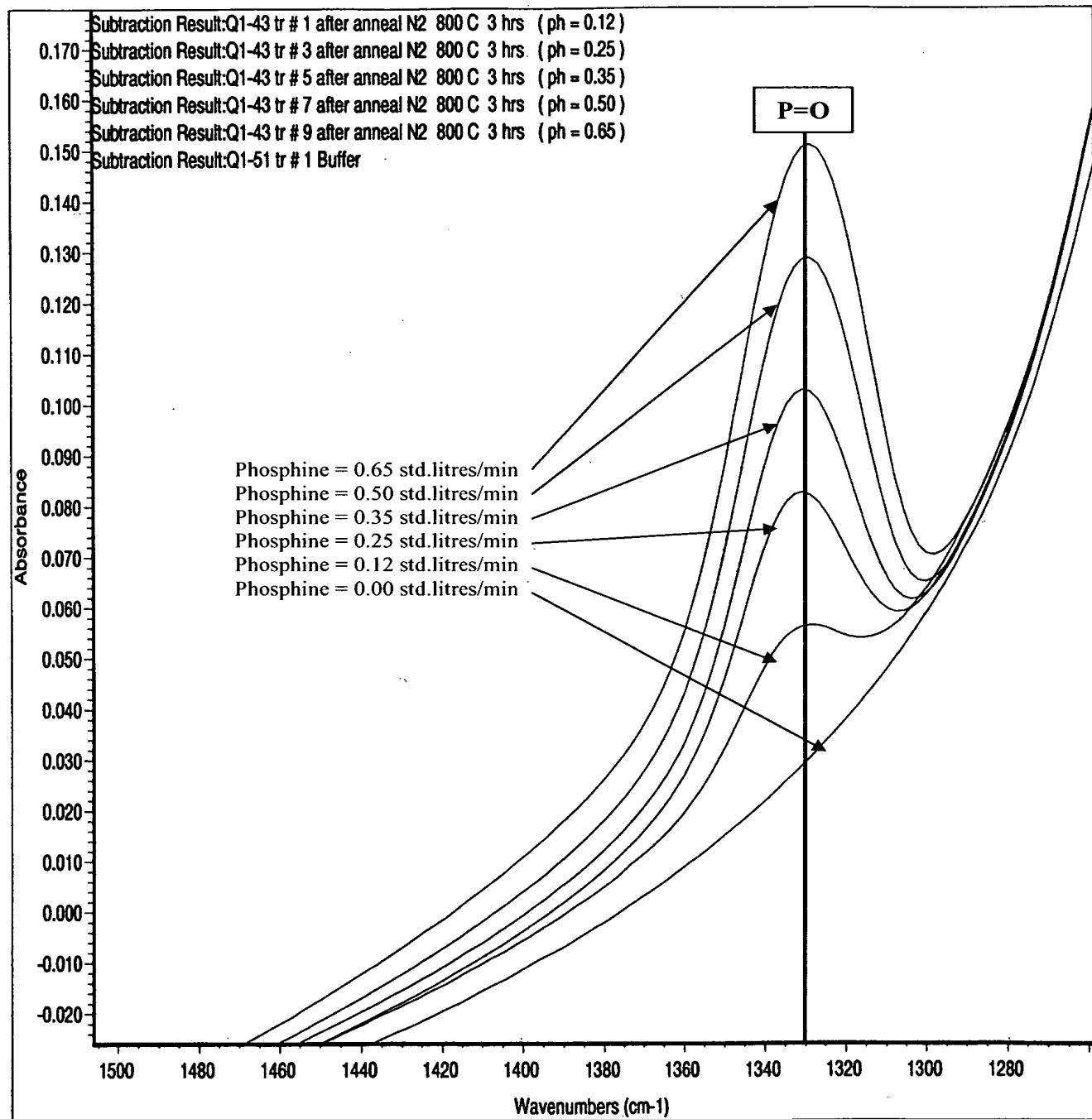


Figure 5d

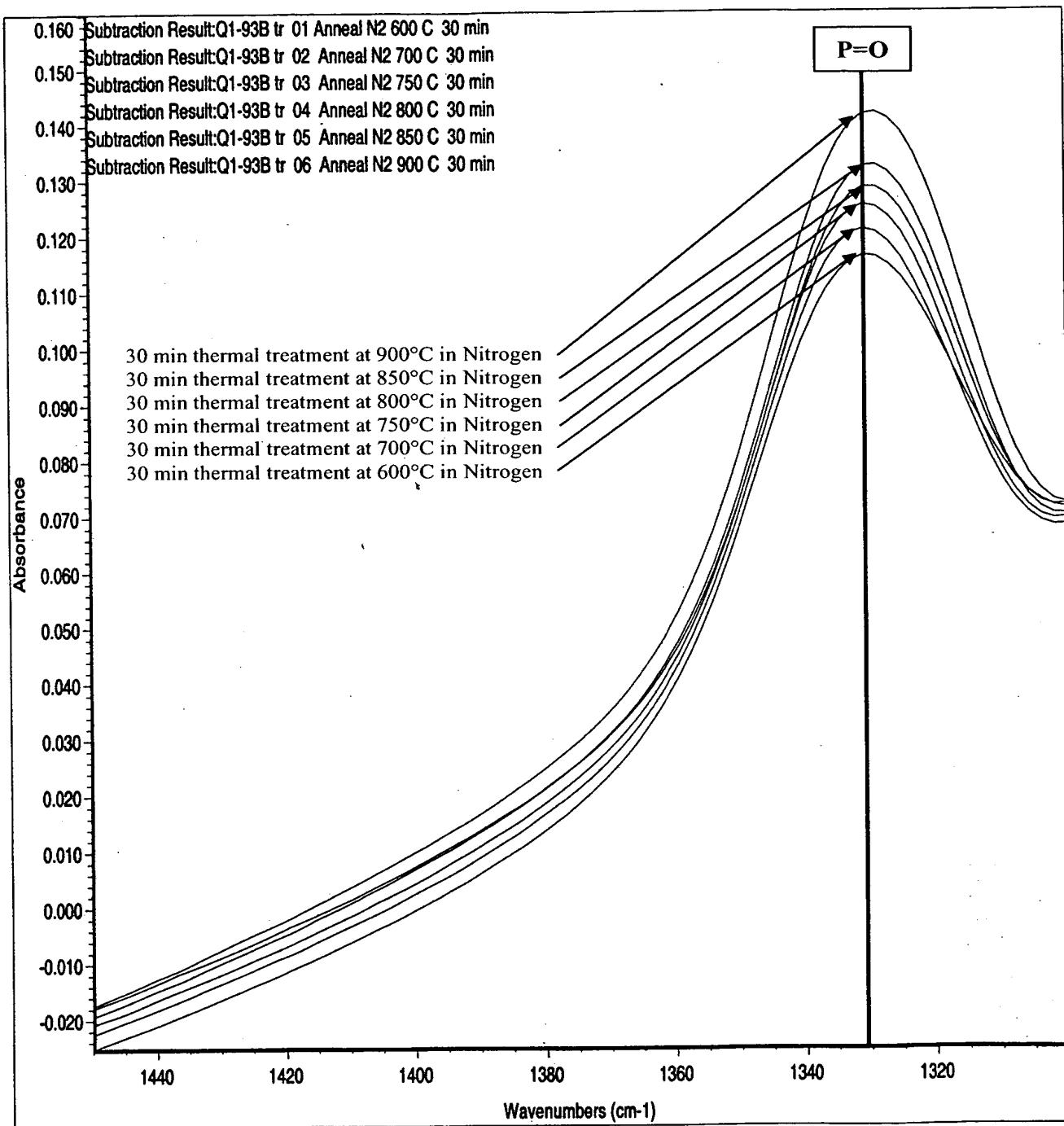


Figure 6a

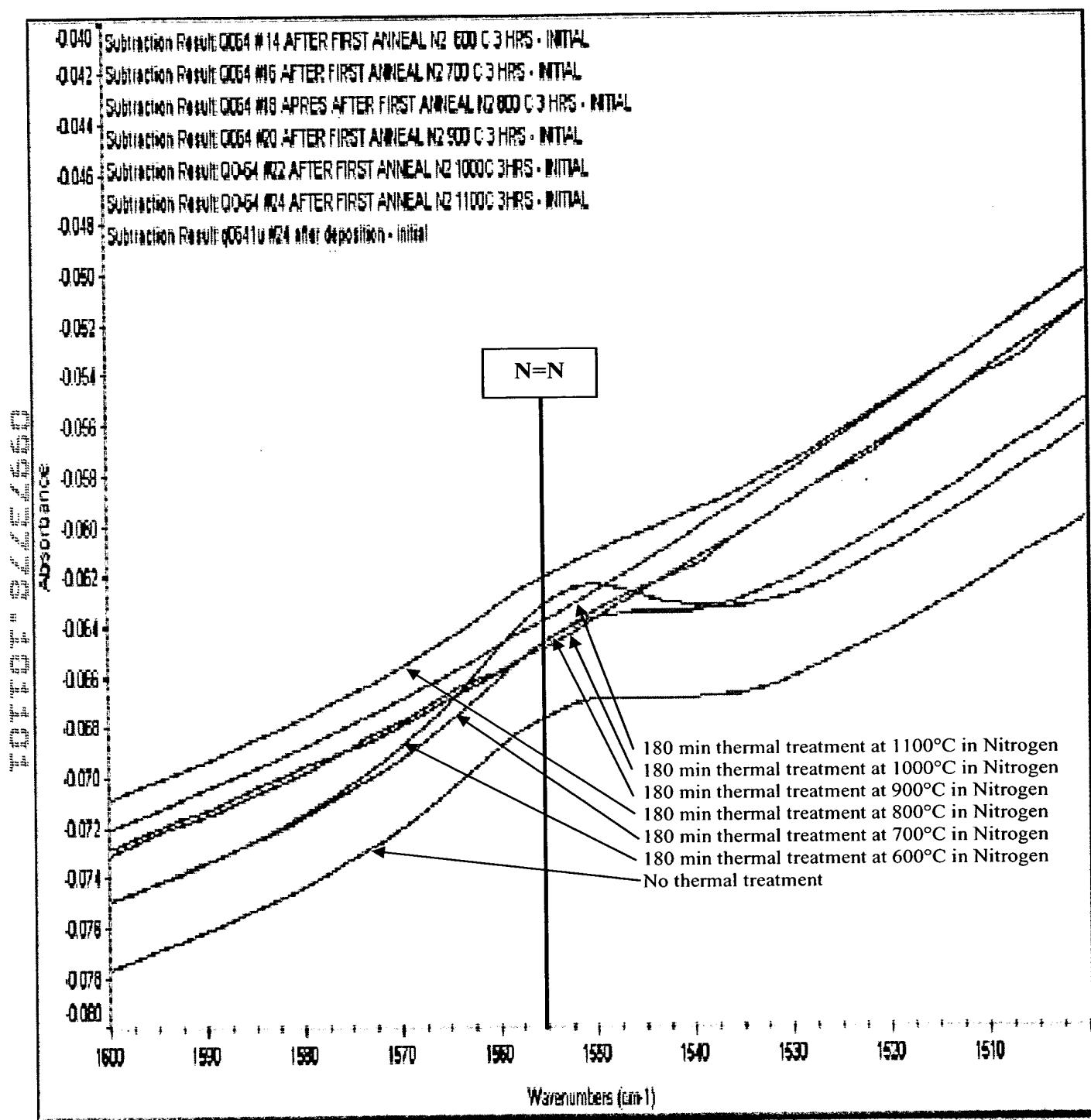


Figure 6b

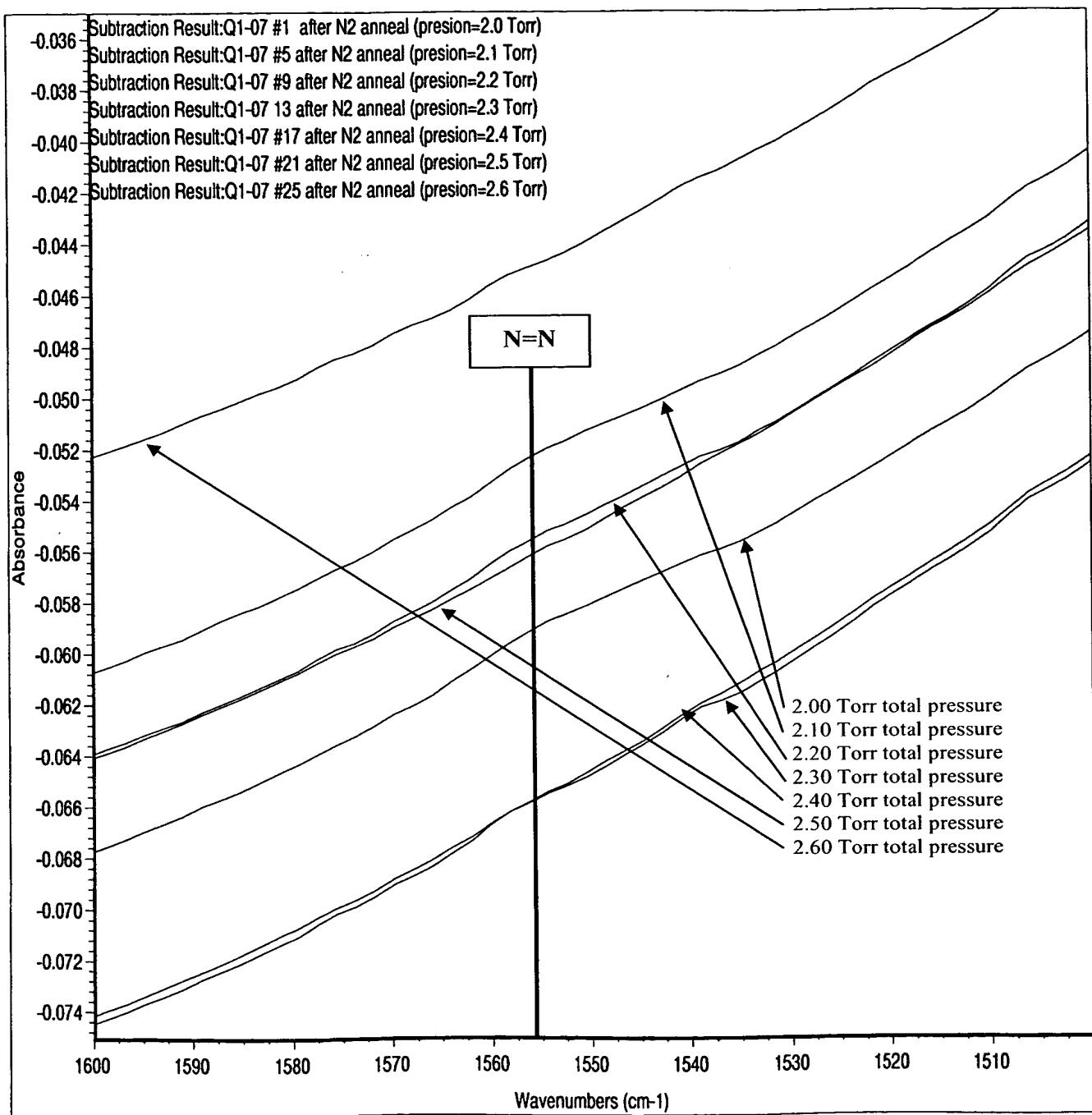


Figure 6c

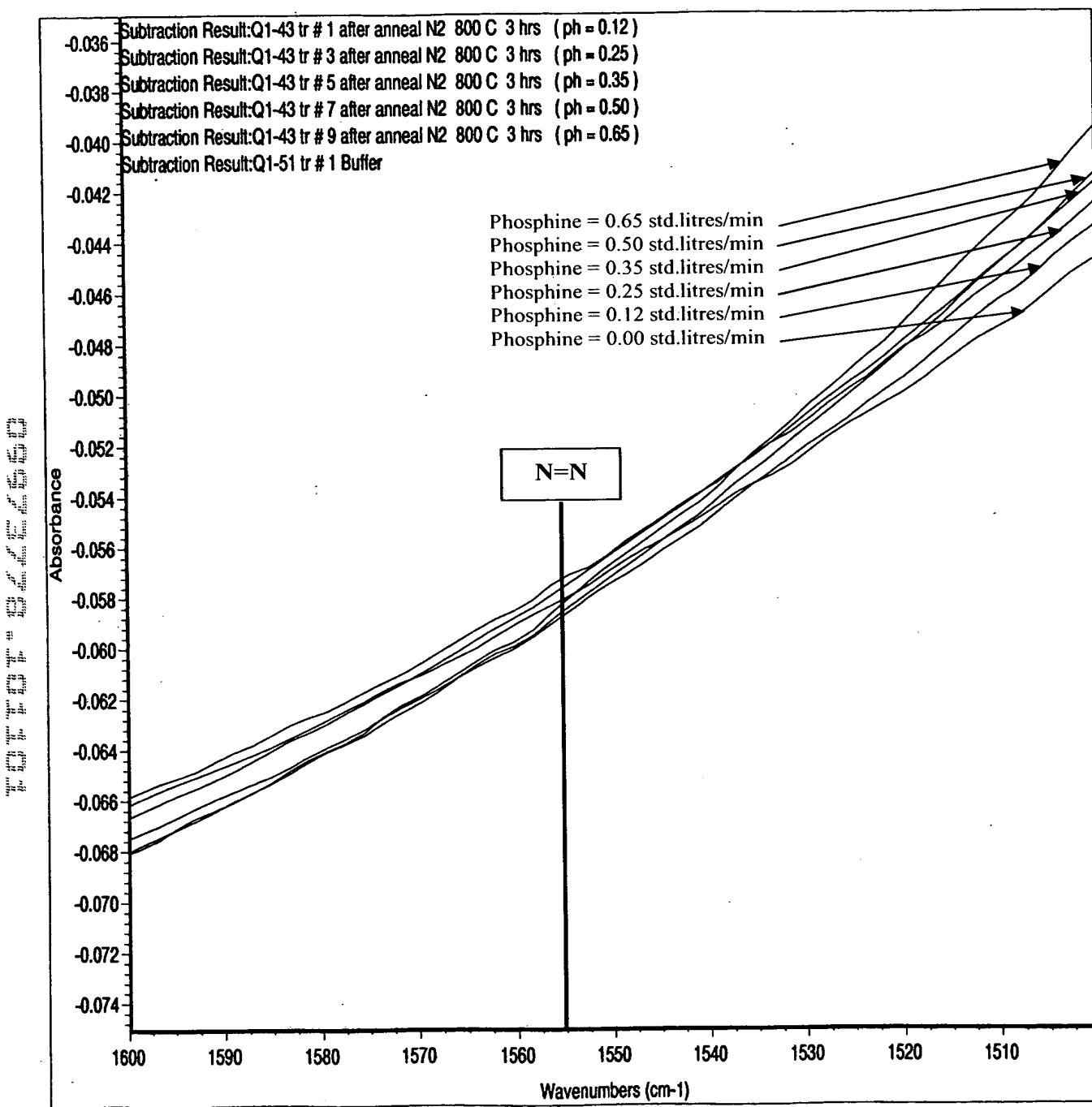


Figure 6d

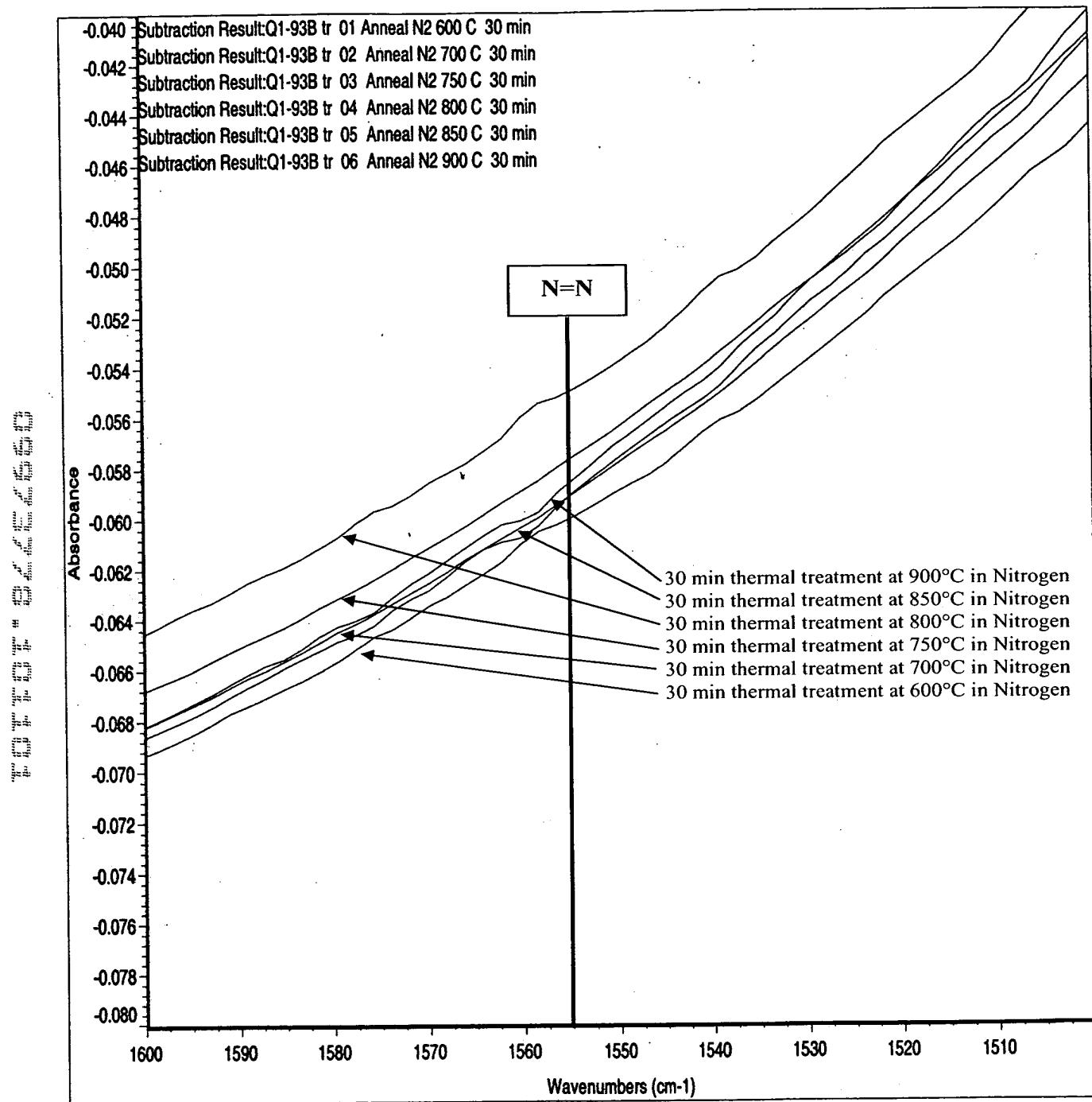


Figure 7a

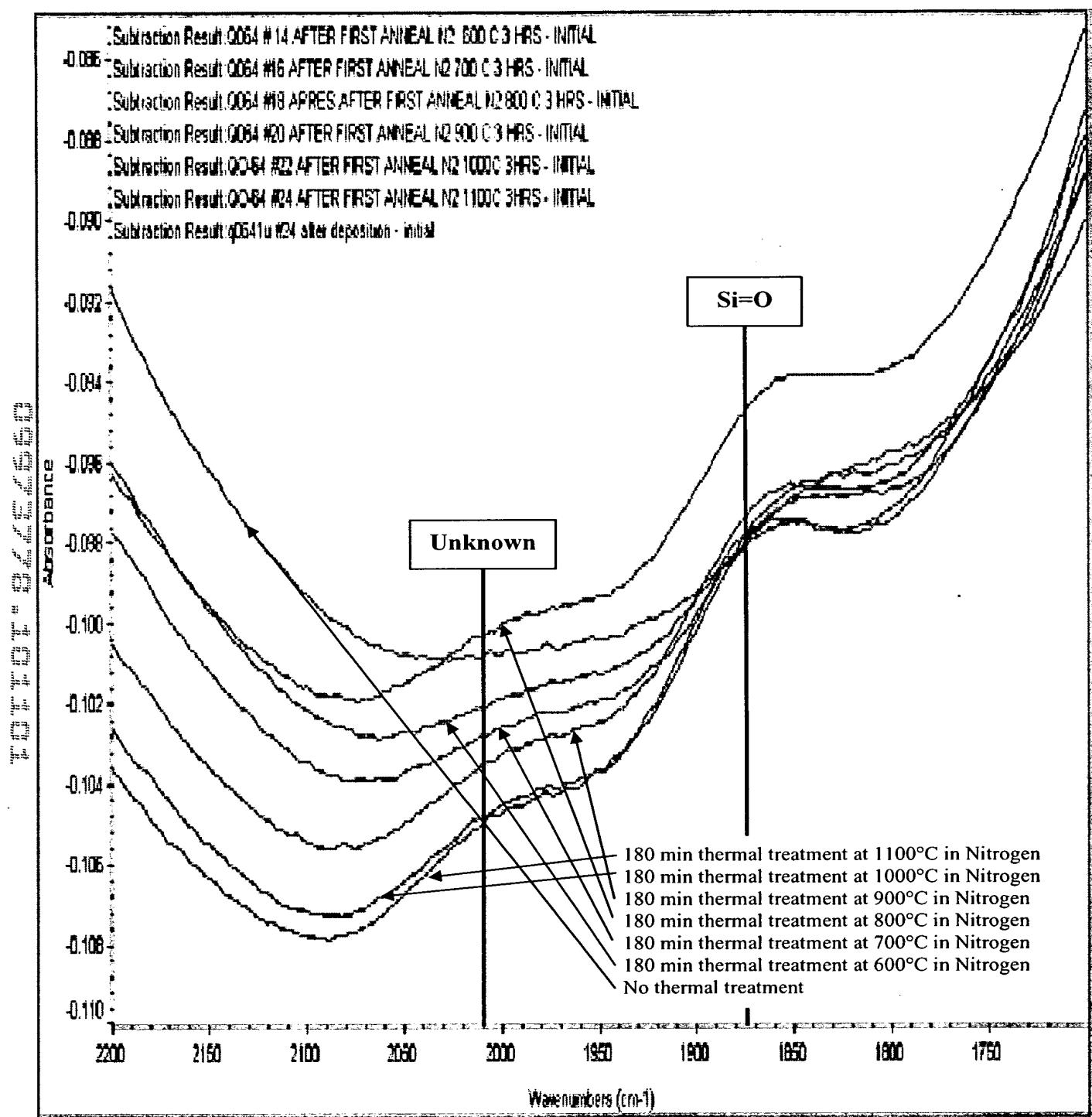


Figure 7b

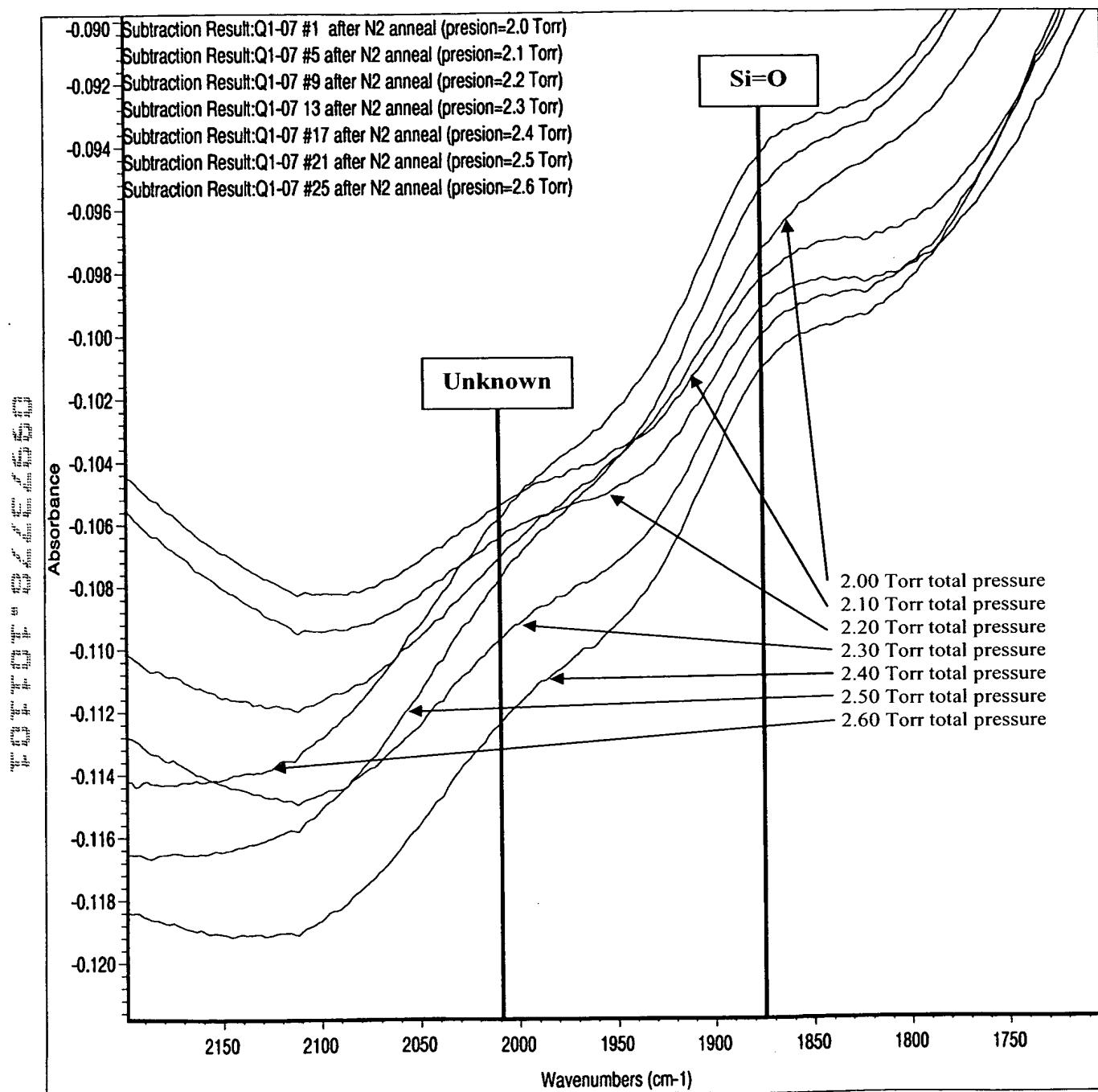


Figure 7c

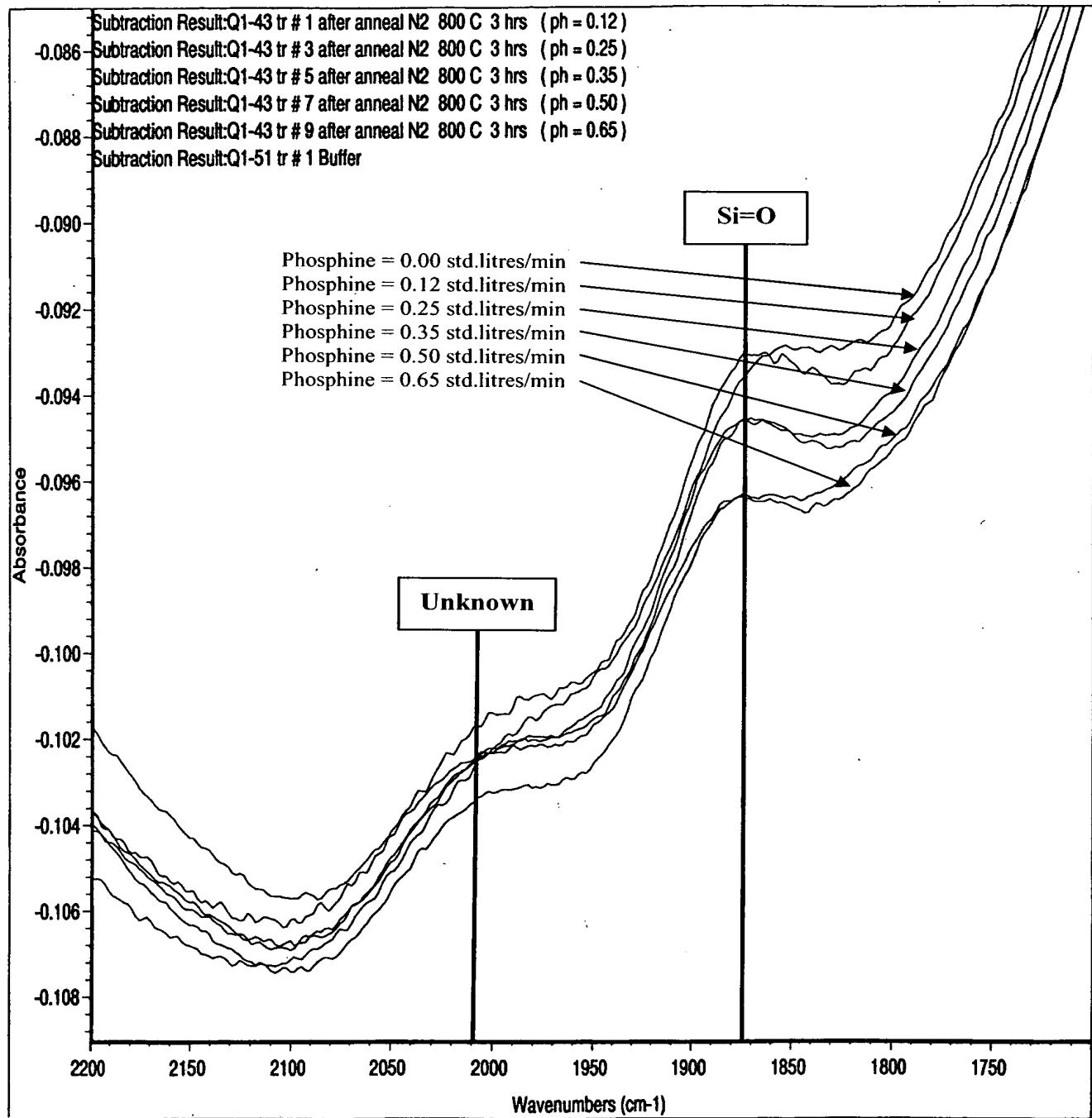


Figure 7d

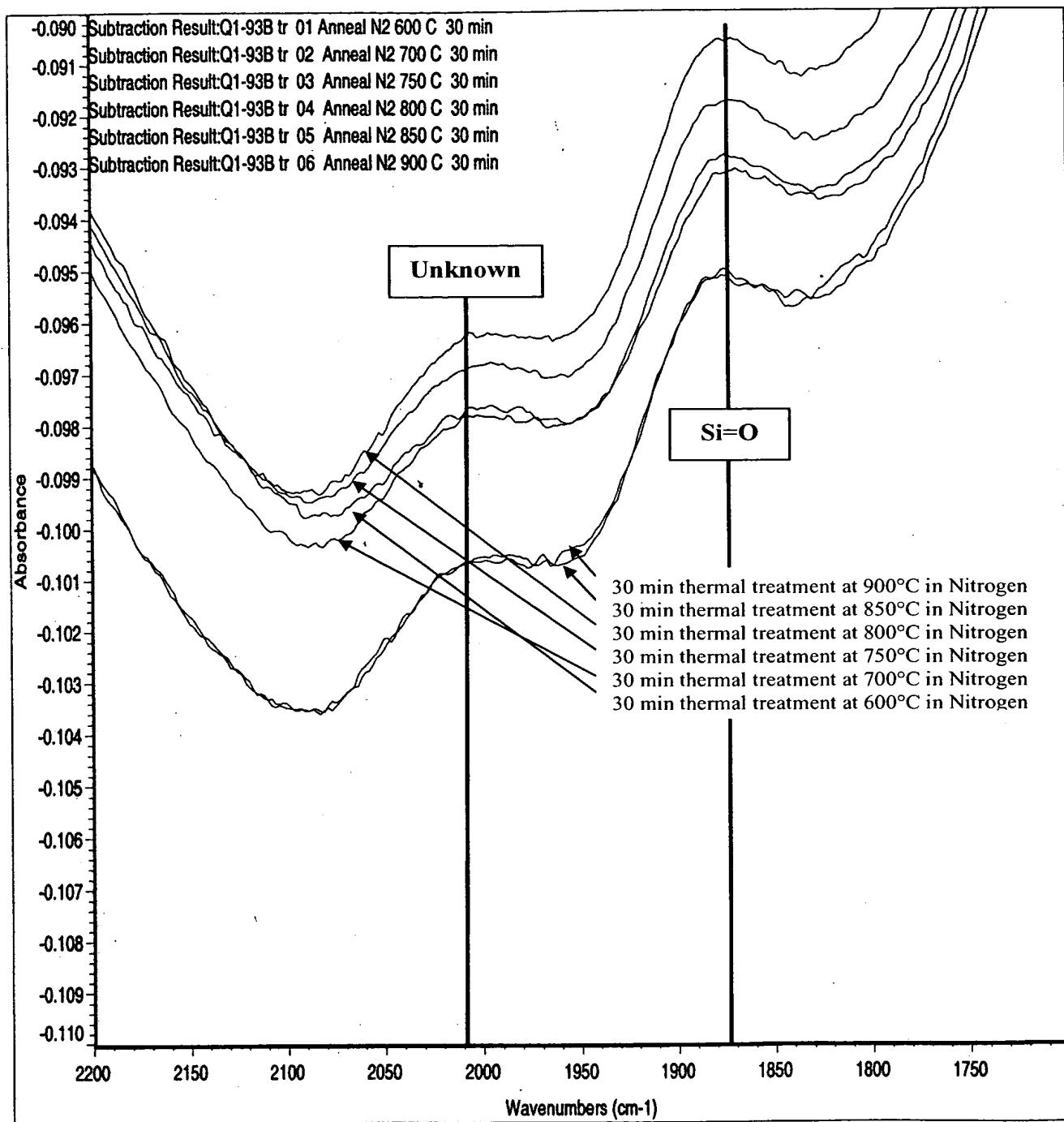


Figure 8a

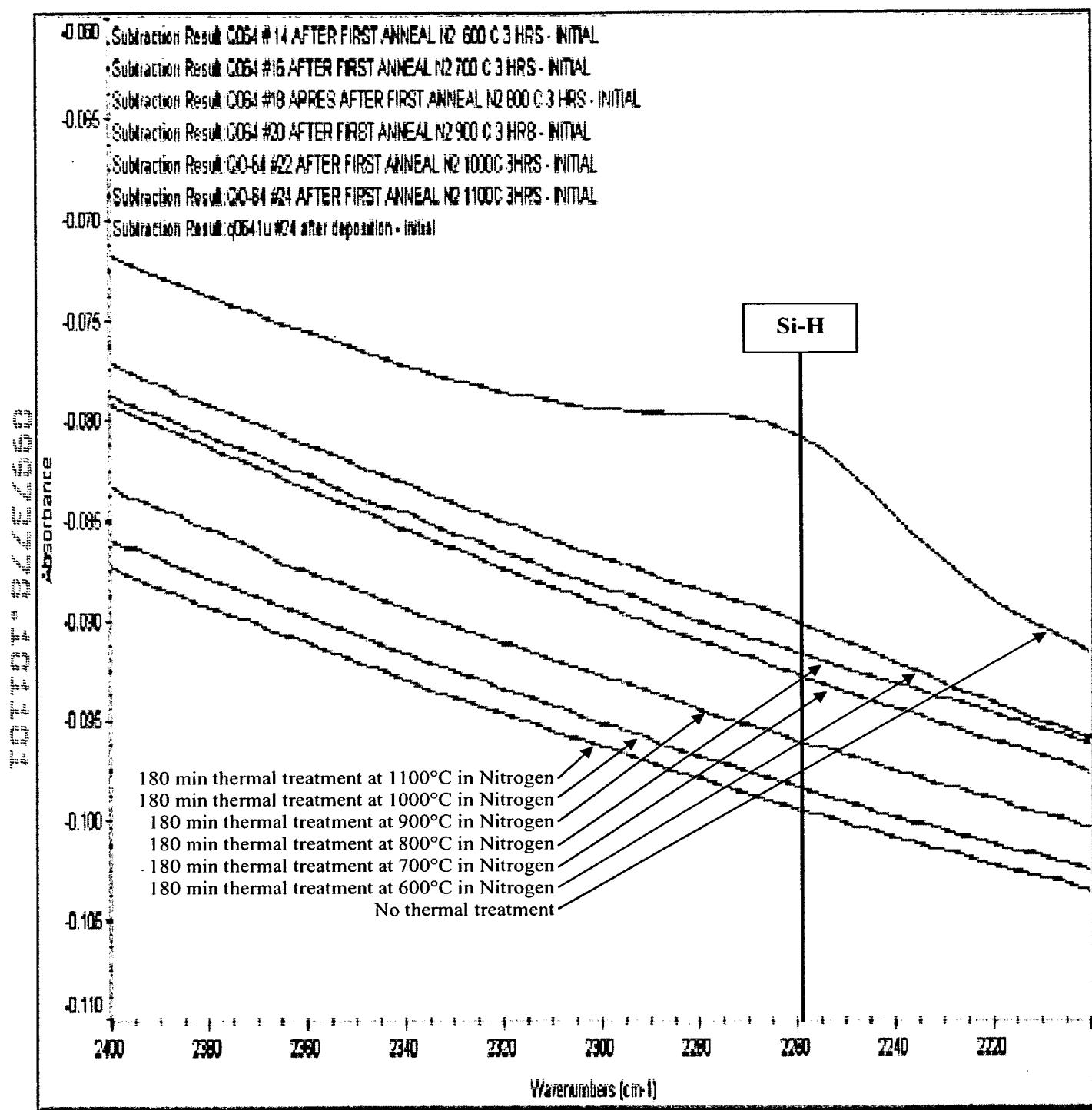


Figure 8b

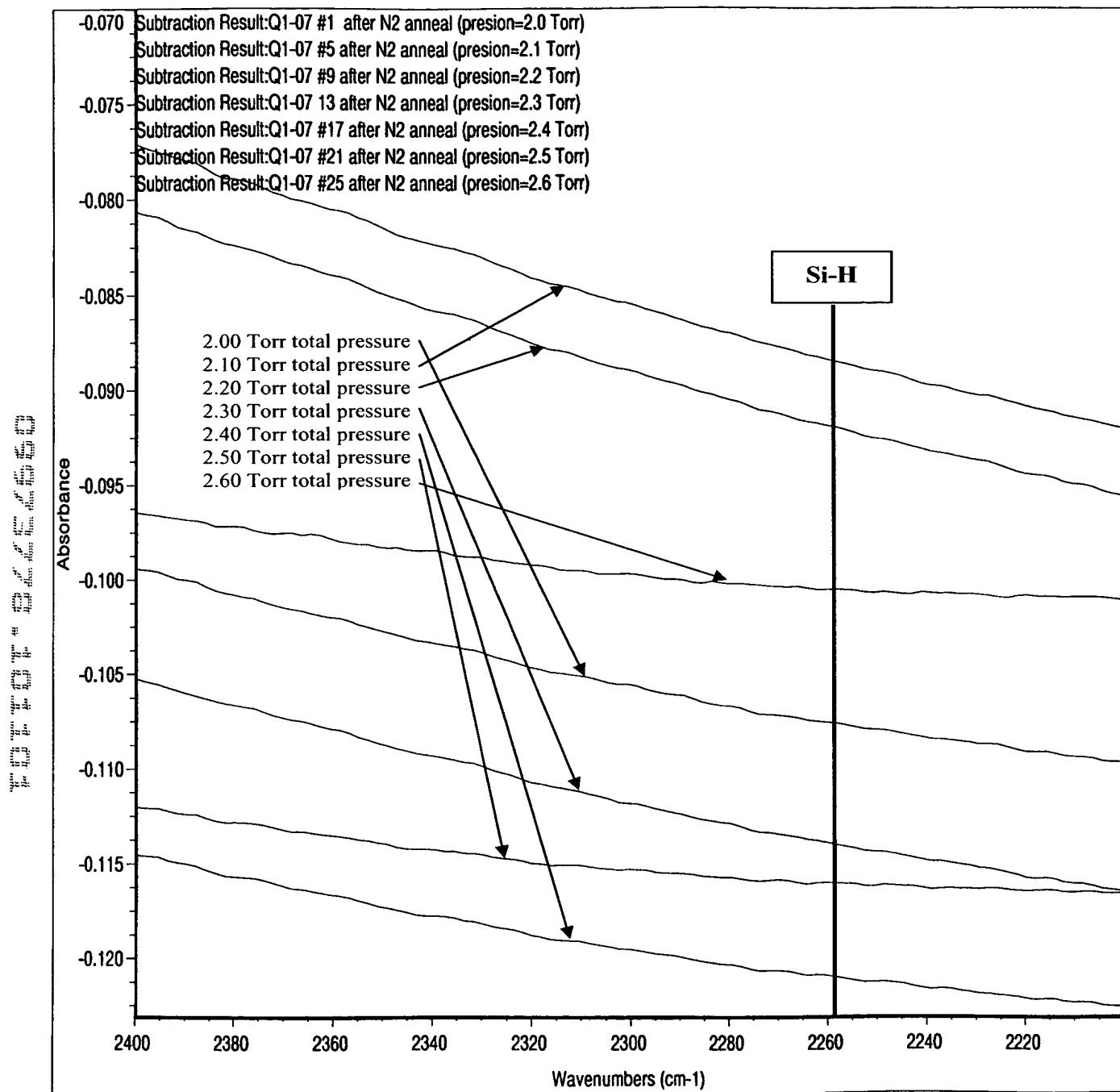


Figure 8c

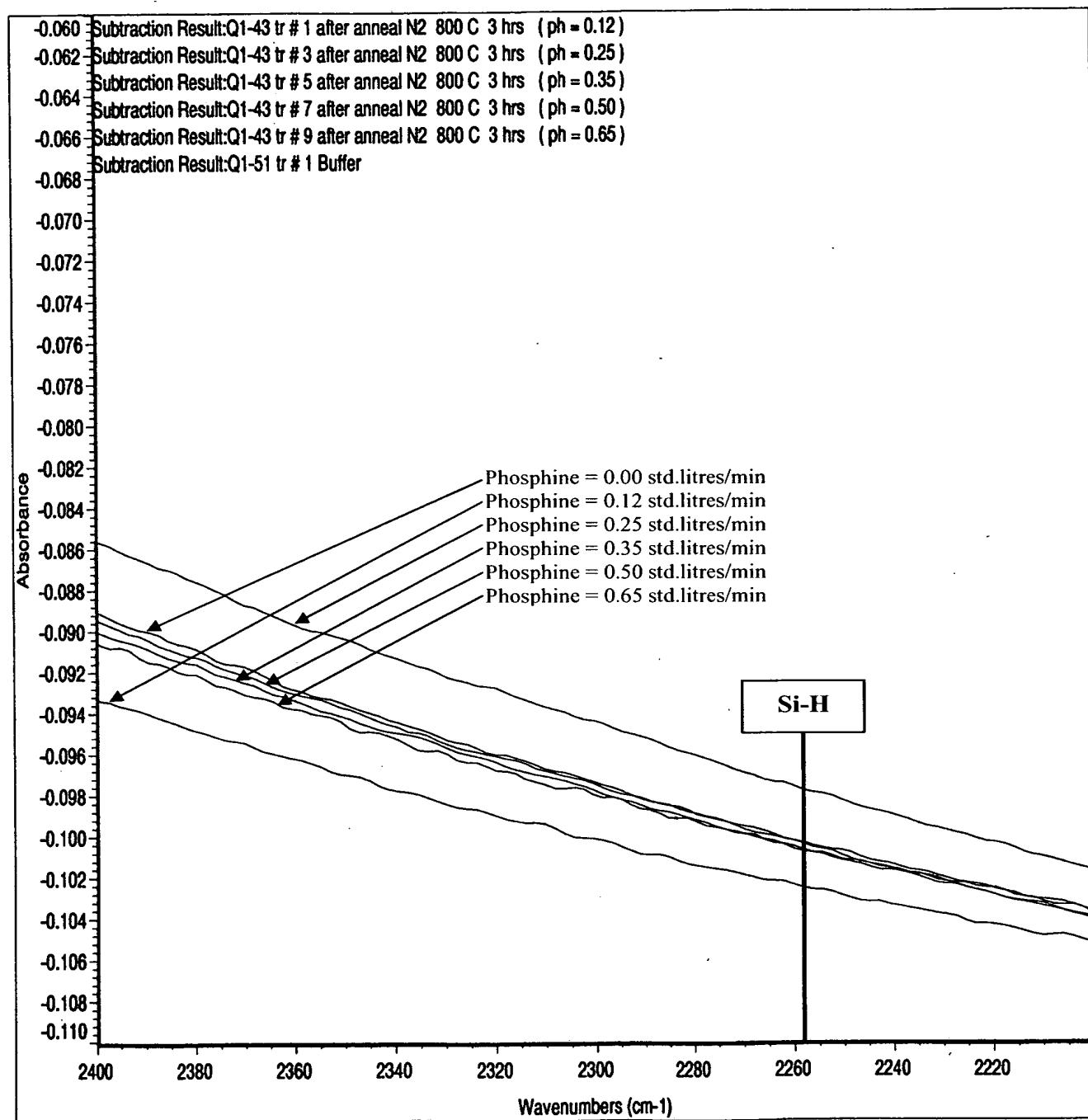


Figure 8d

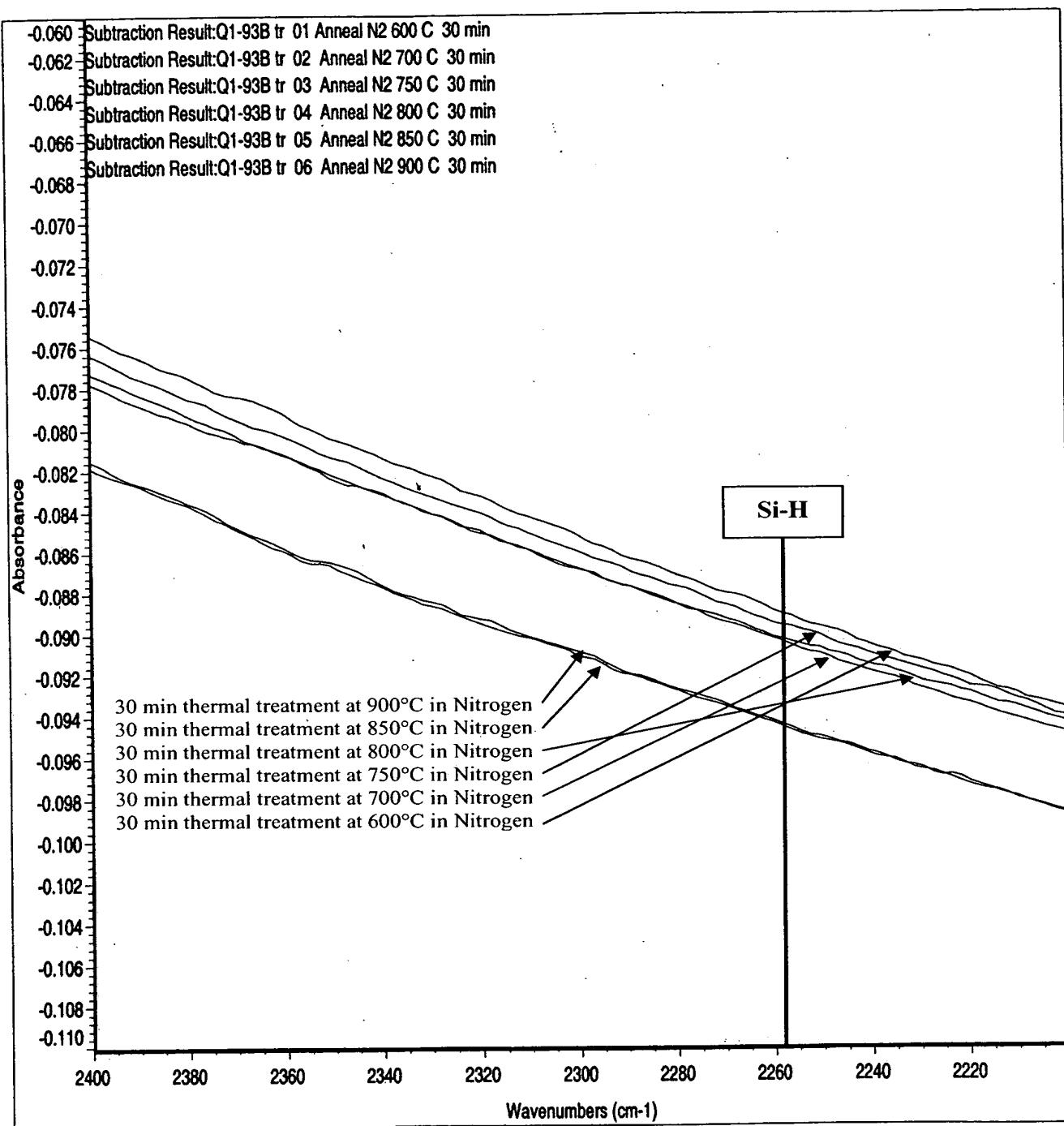


Figure 9a

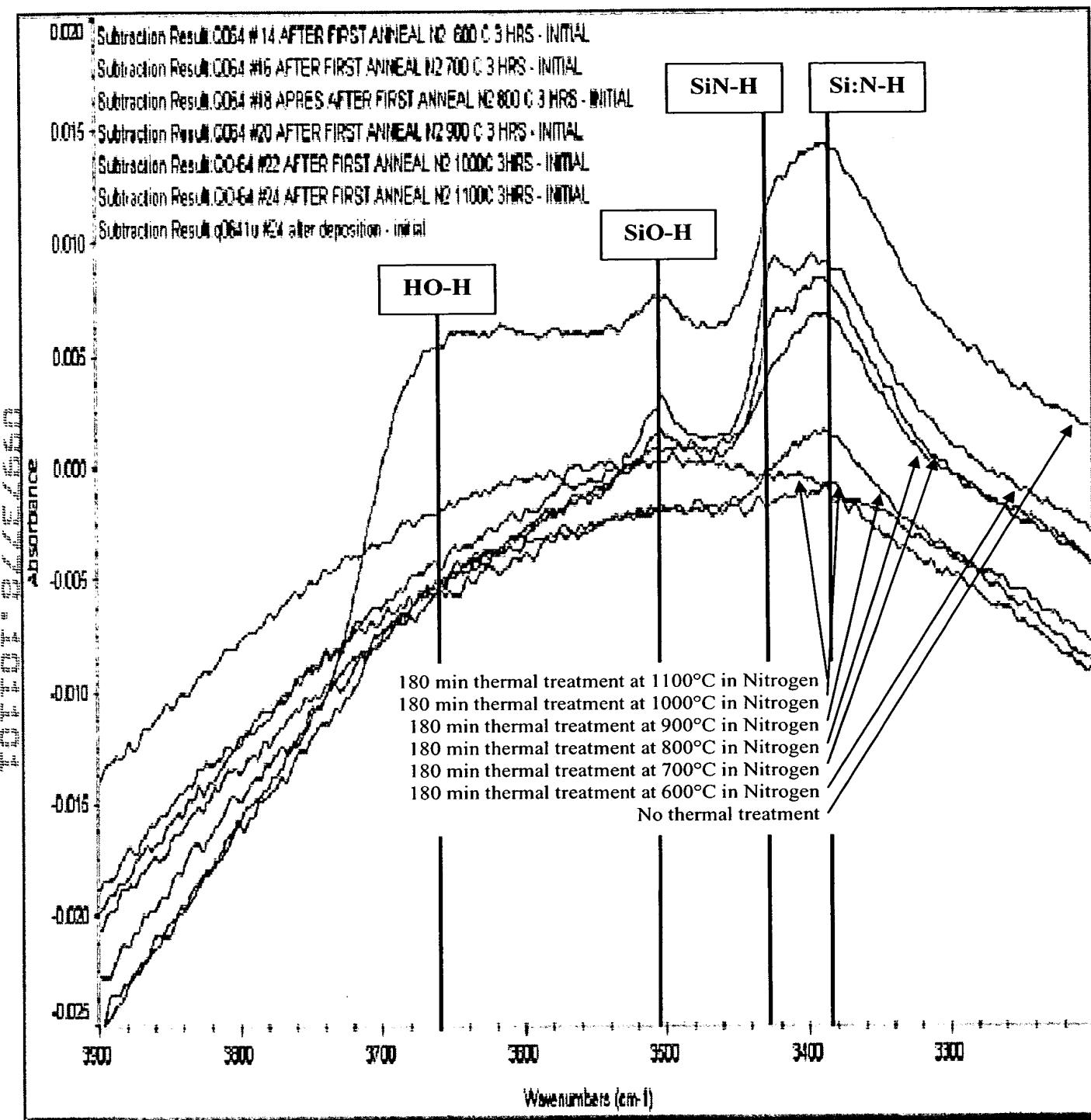


Figure 9b

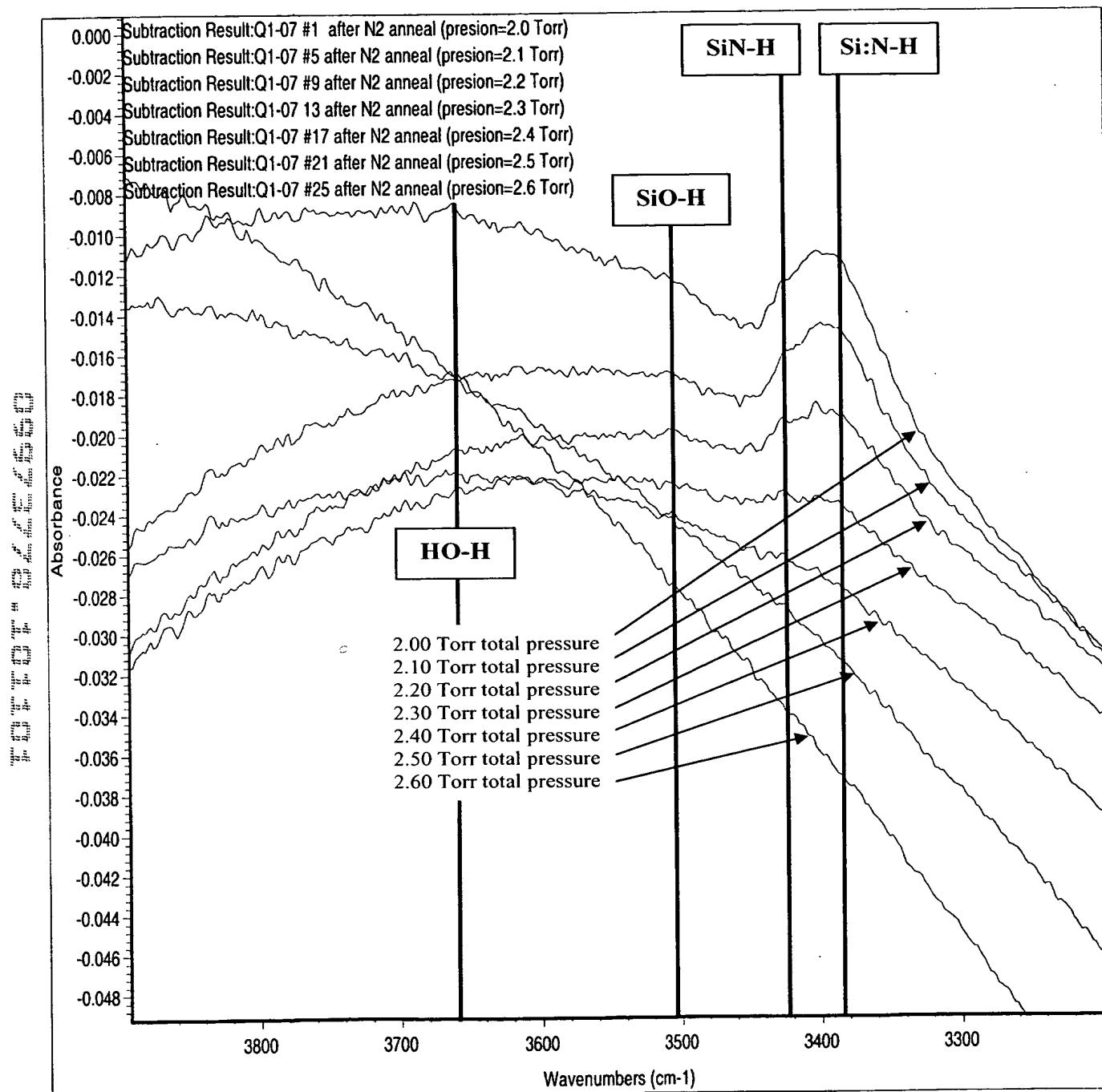


Figure 9c

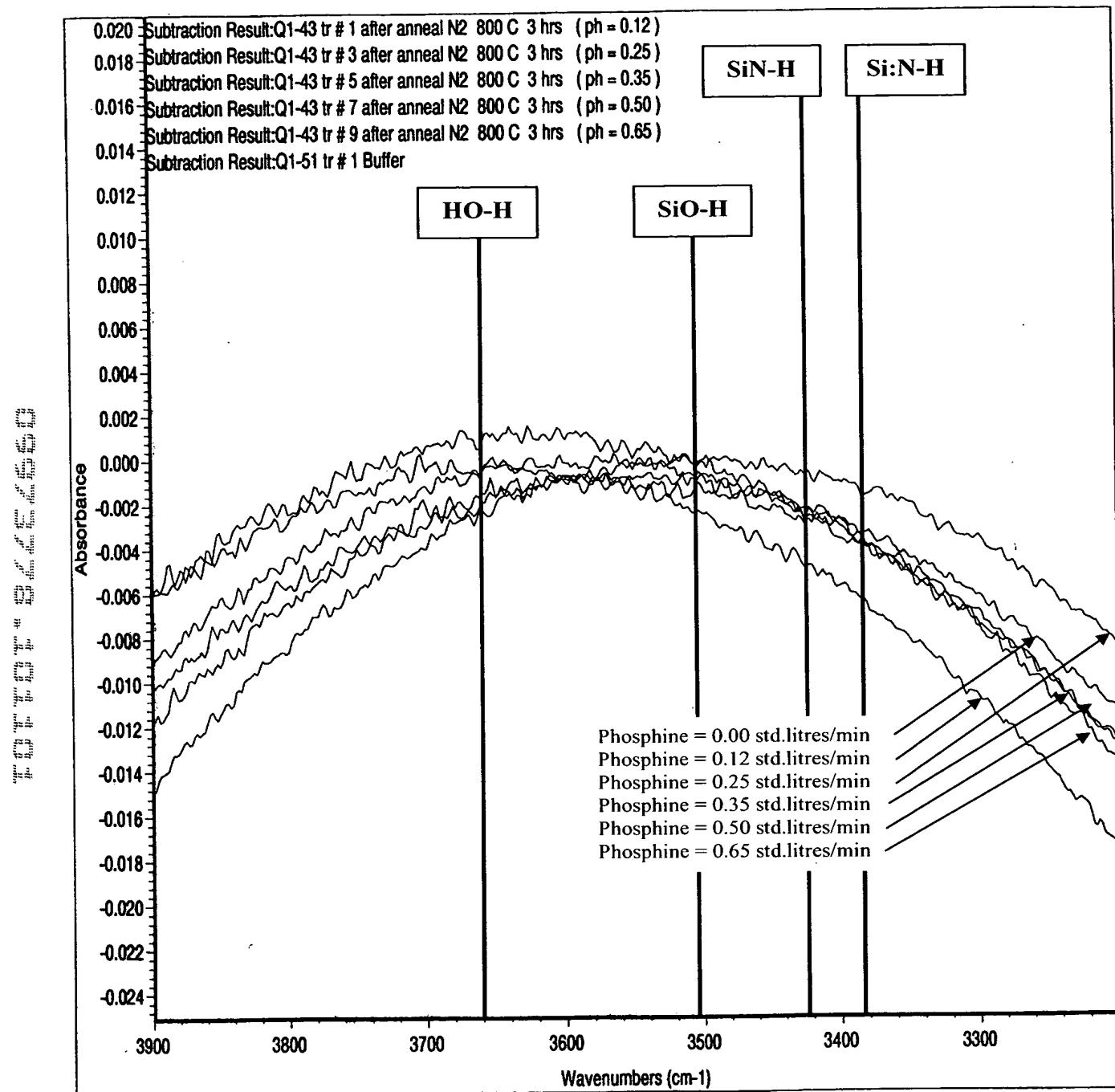


Figure 9d

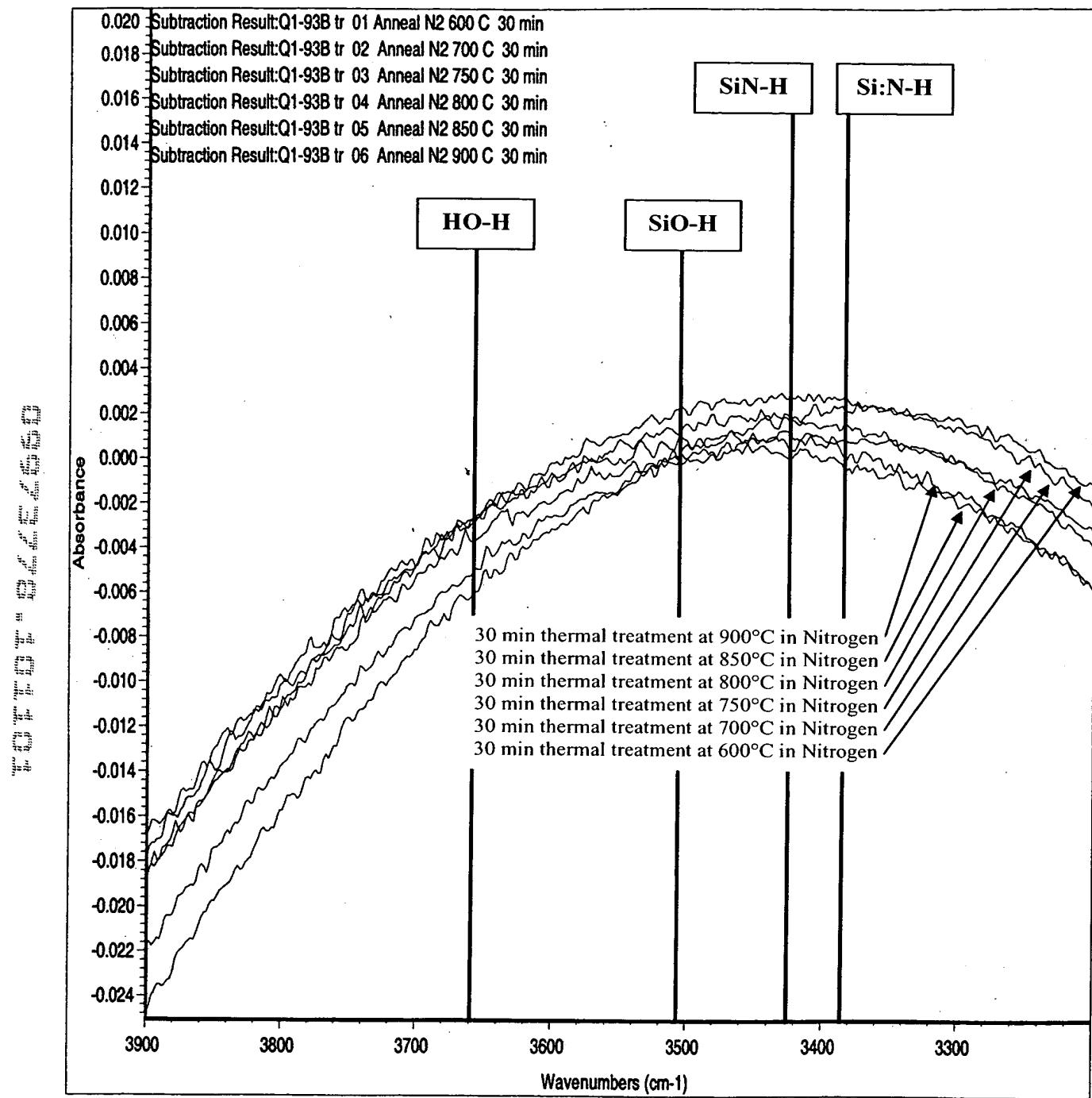
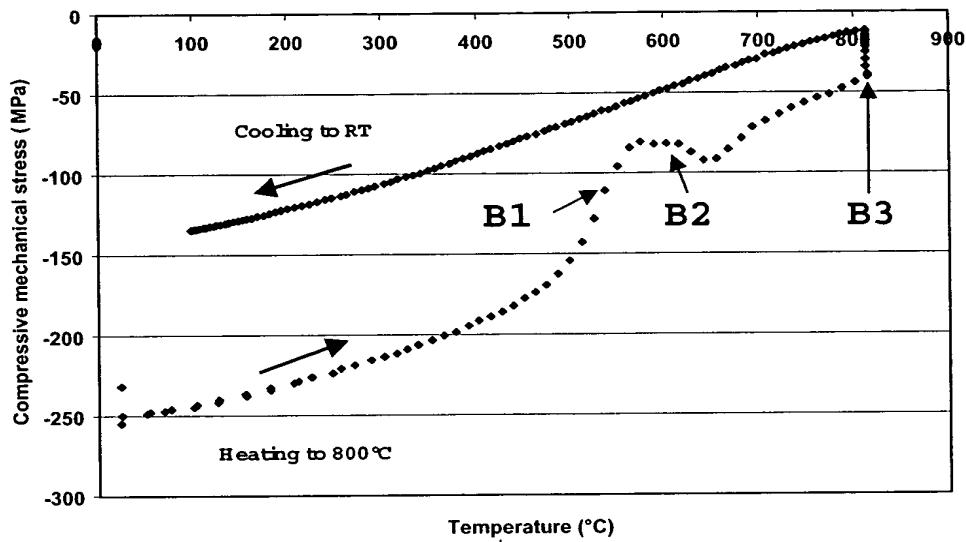


Figure 10

Buffer (Clad) compressive mechanical stress during a 180 minutes thermal treatment in a nitrogen ambient



Core tensile mechanical stress during a 180 minutes thermal treatment in a nitrogen ambient

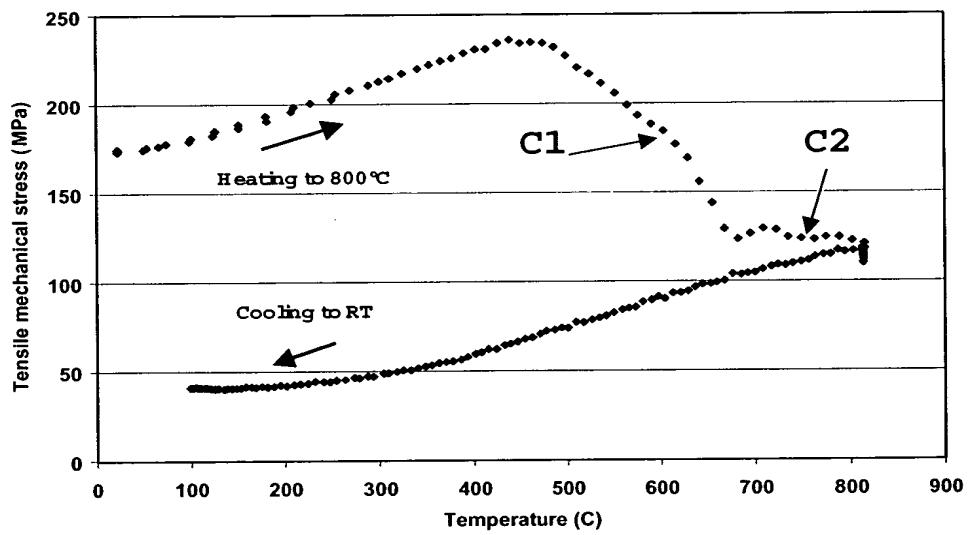


Figure 11

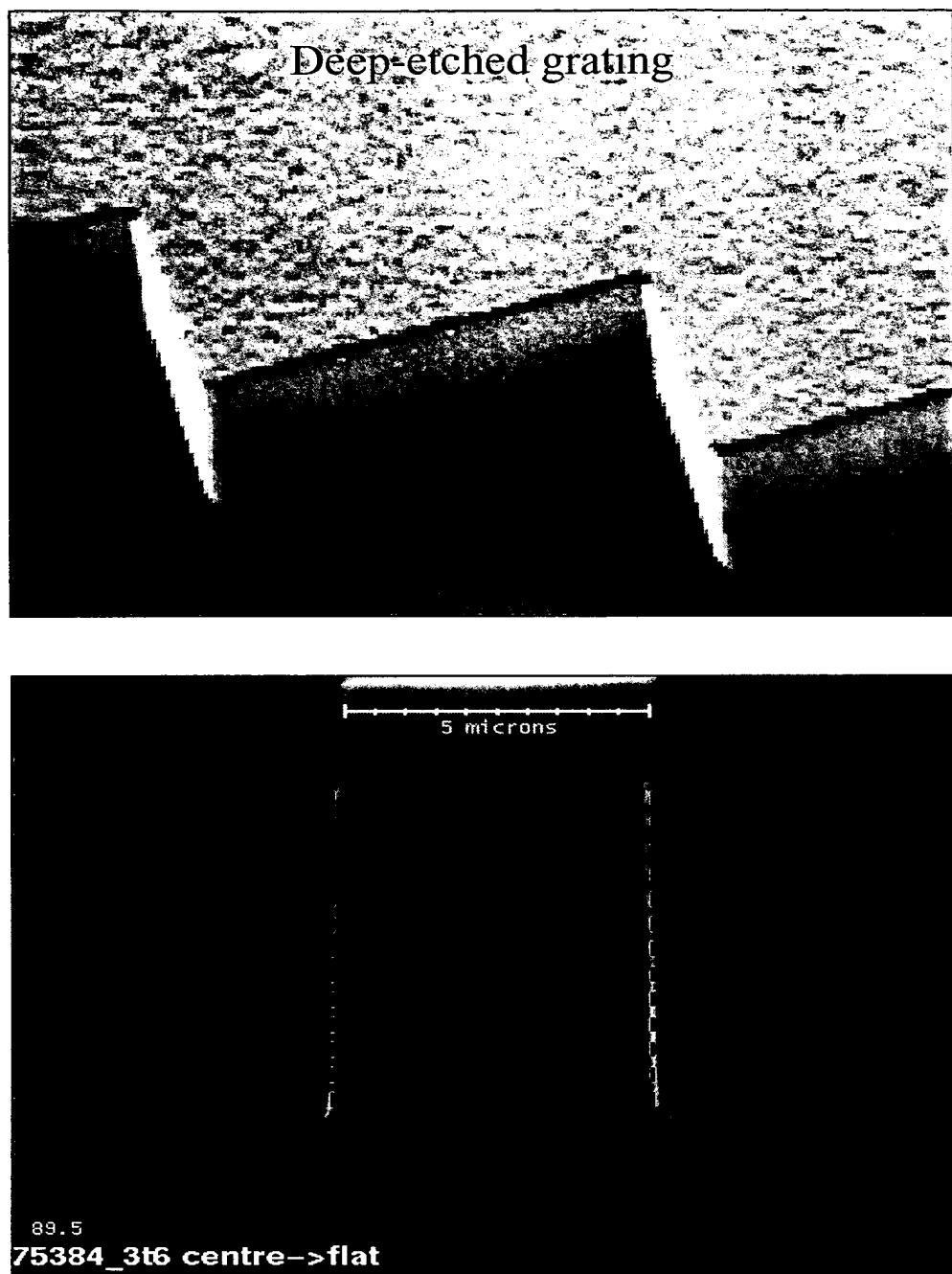


Figure 12

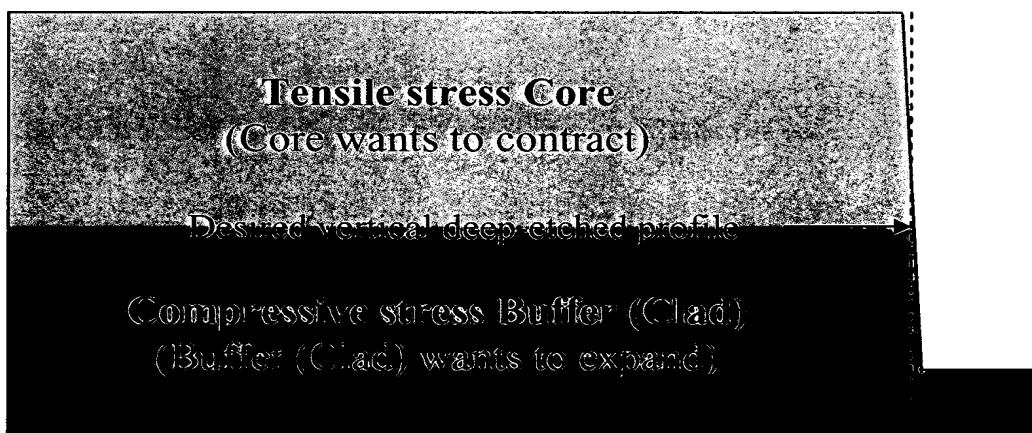
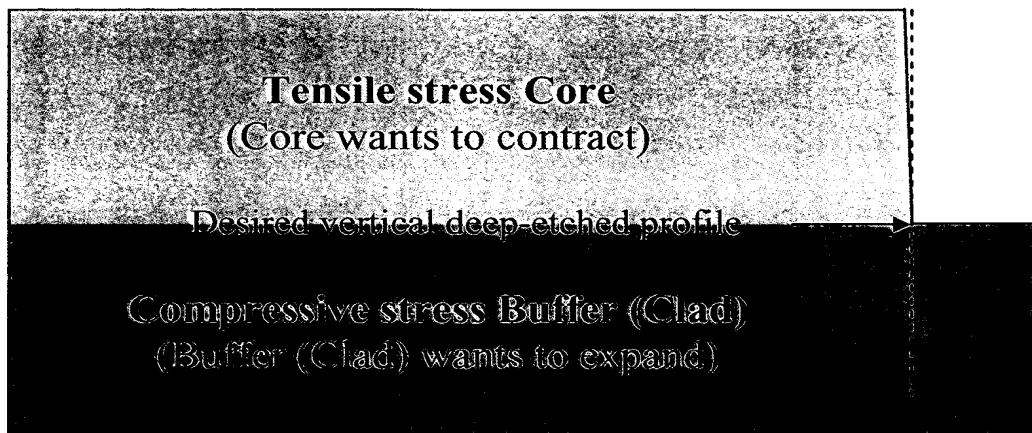
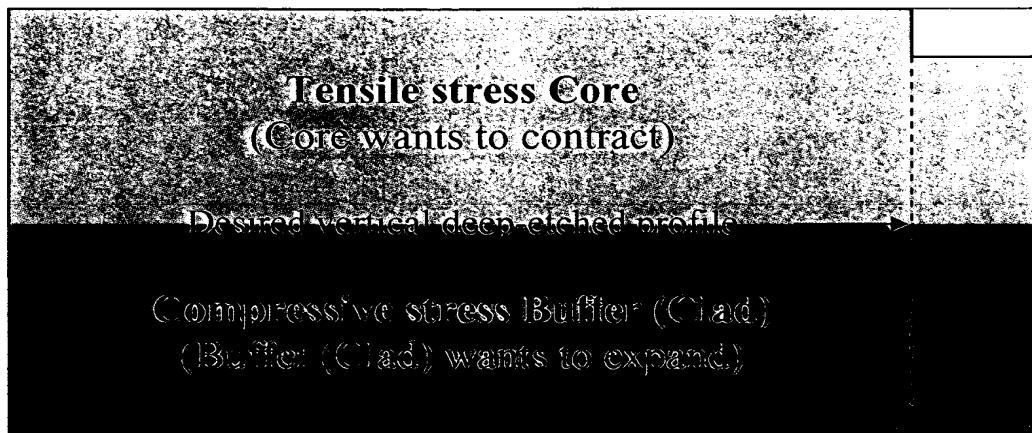
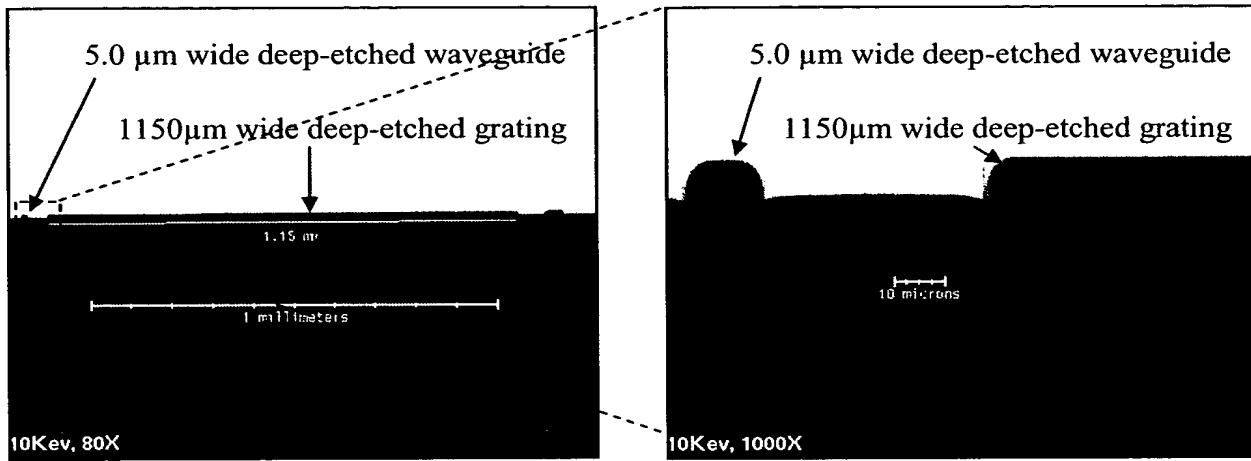
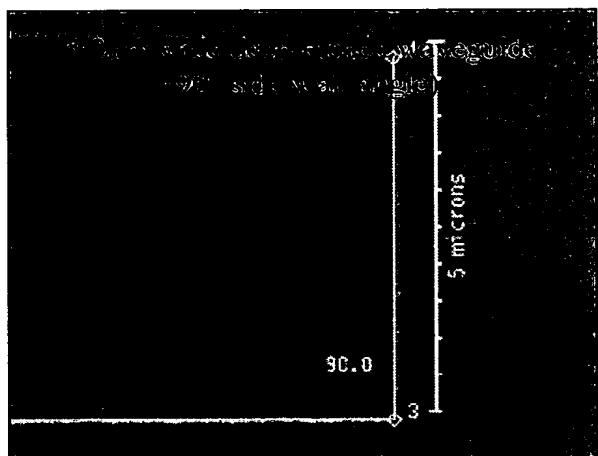


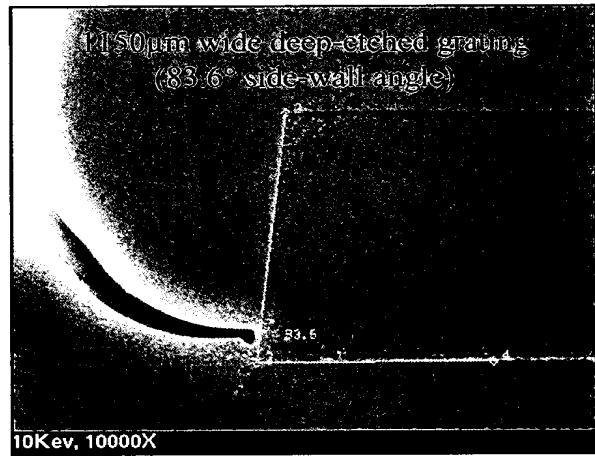
Figure 13



The relative position between an isolated 5.0 μm wide deep-etched waveguide and its neighboring 1150 μm wide deep-etched grating at two different magnifications.



The side-wall of the 5.0 μm wide deep-etched waveguide facing the neighboring grating has a slope of about 90°.



The side-wall of the 1150 μm wide deep-etched grating facing the neighboring deep-etched waveguide has a much smaller slope of about 84°.

Figure 14

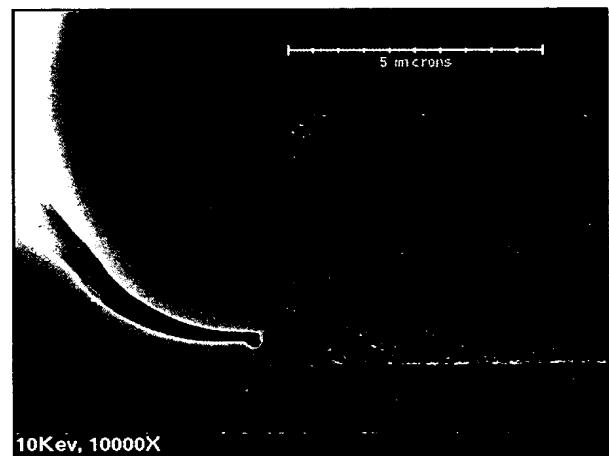
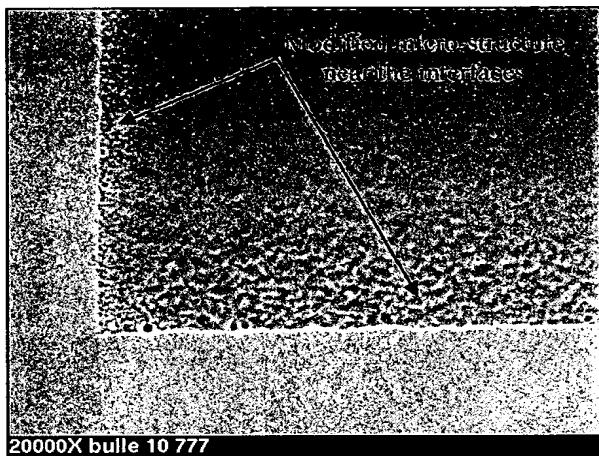
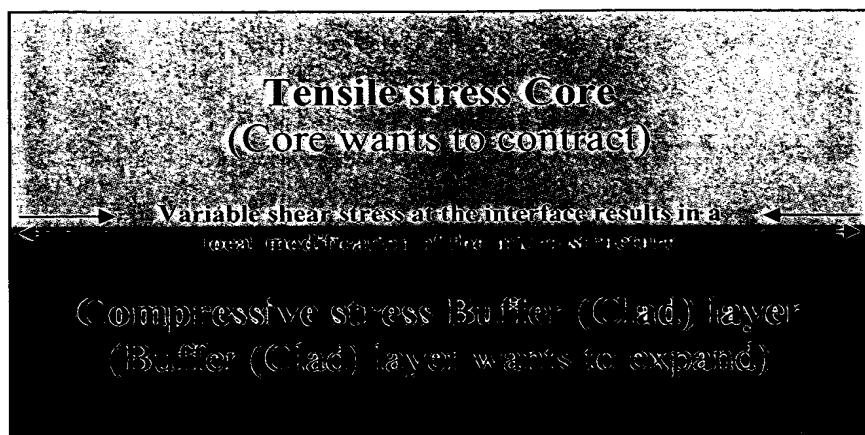


Figure 15

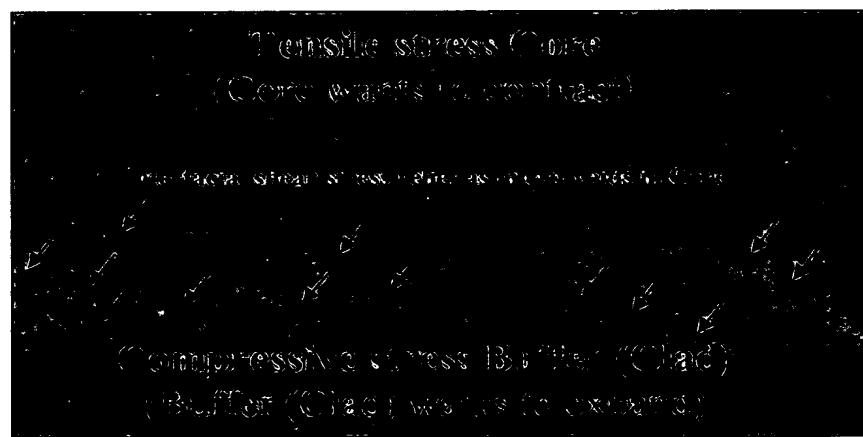
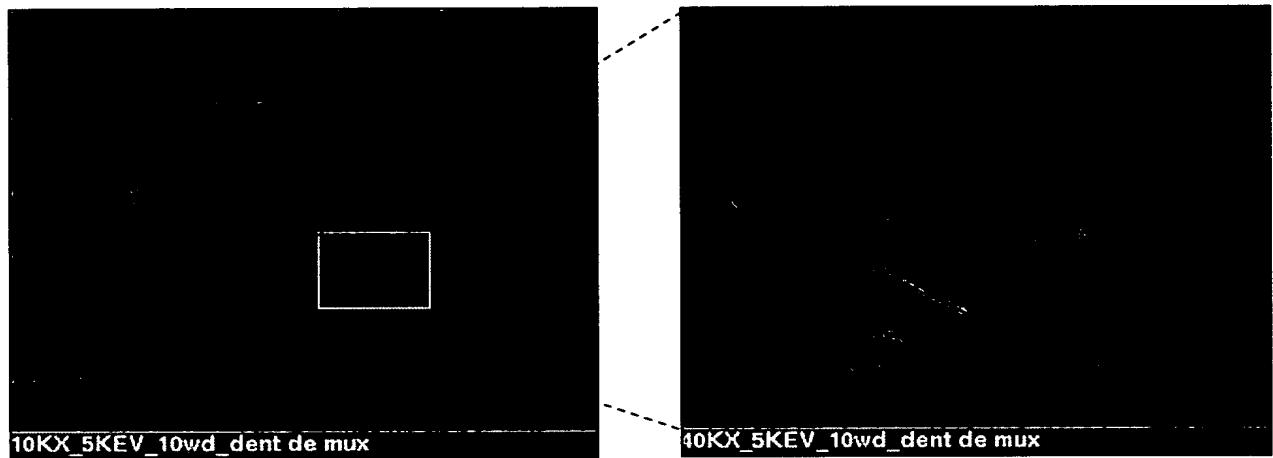
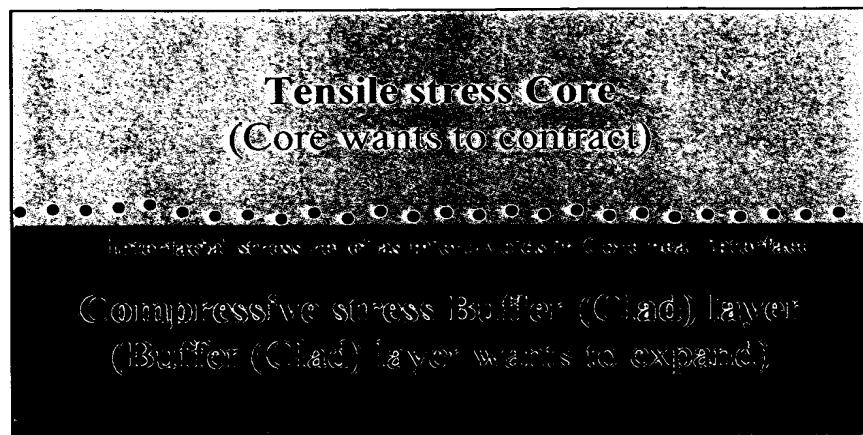


Figure 16

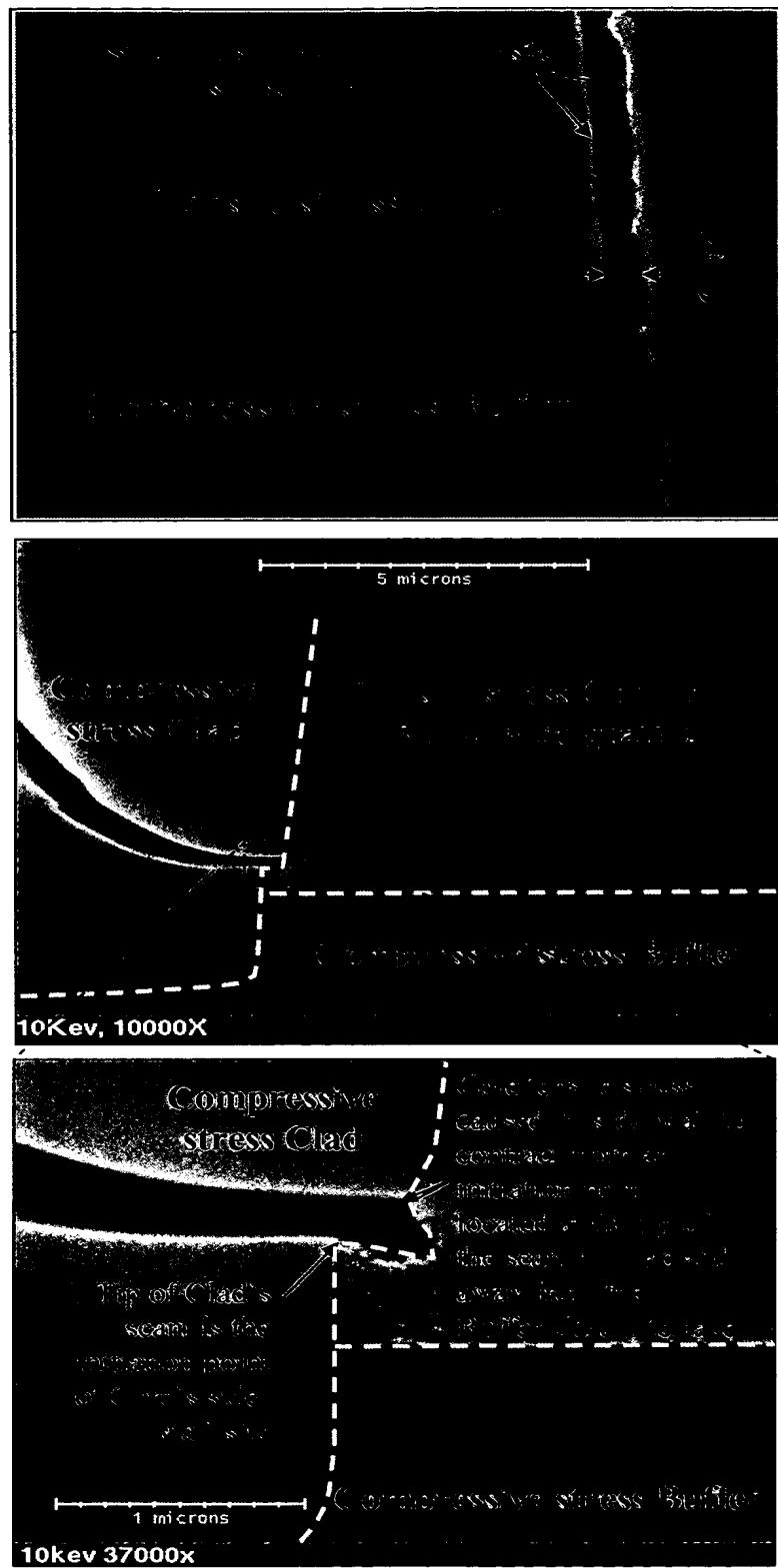


Figure 17

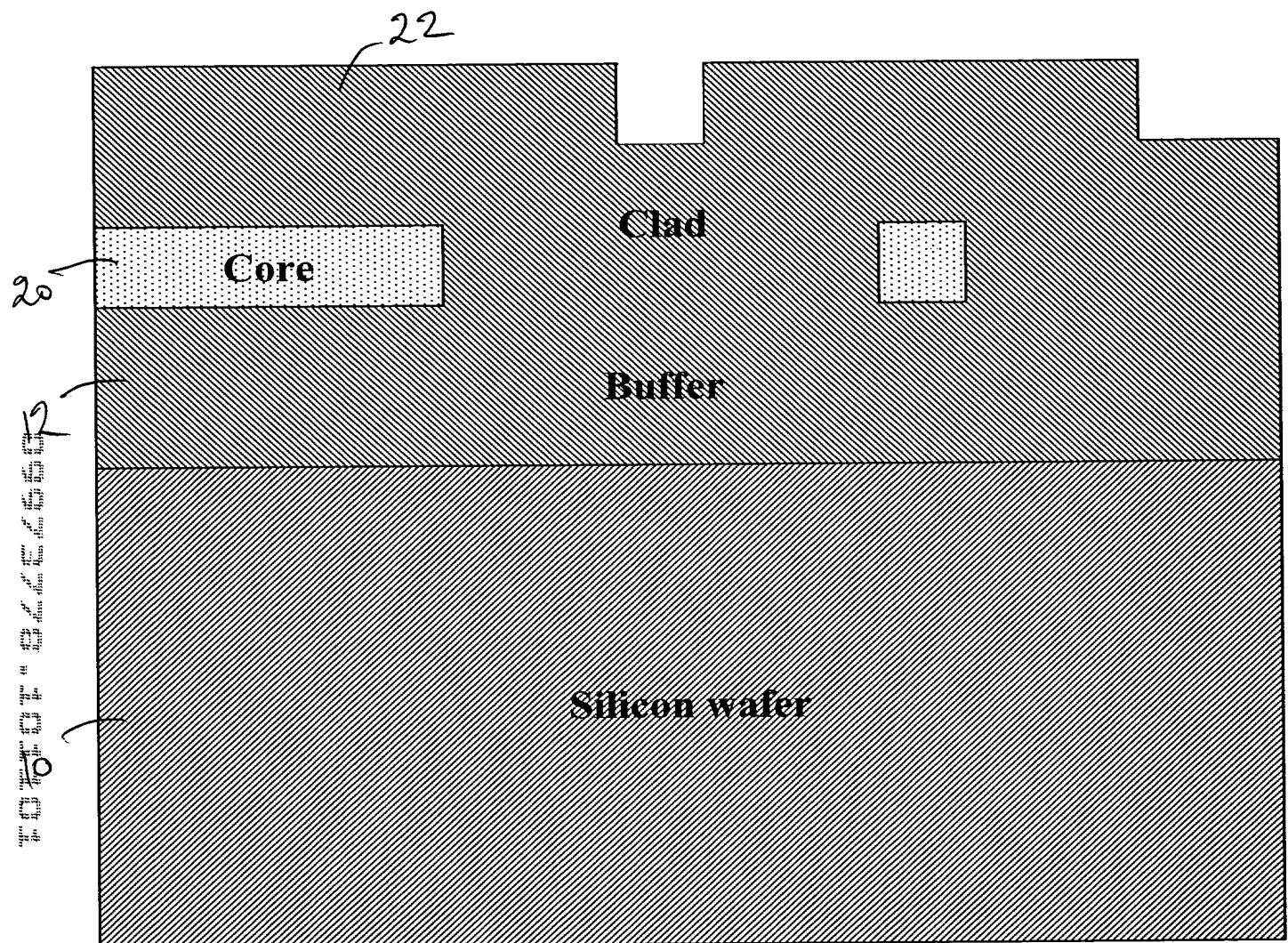


Figure 18a

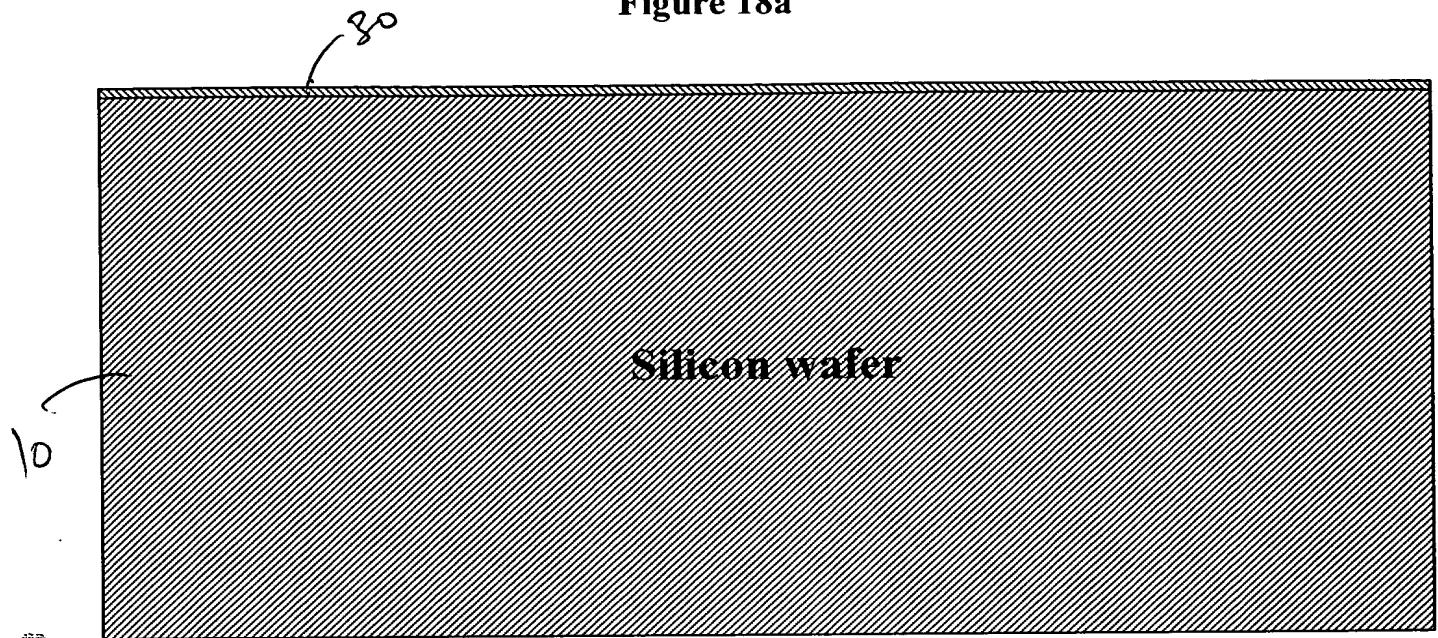


Figure 18b

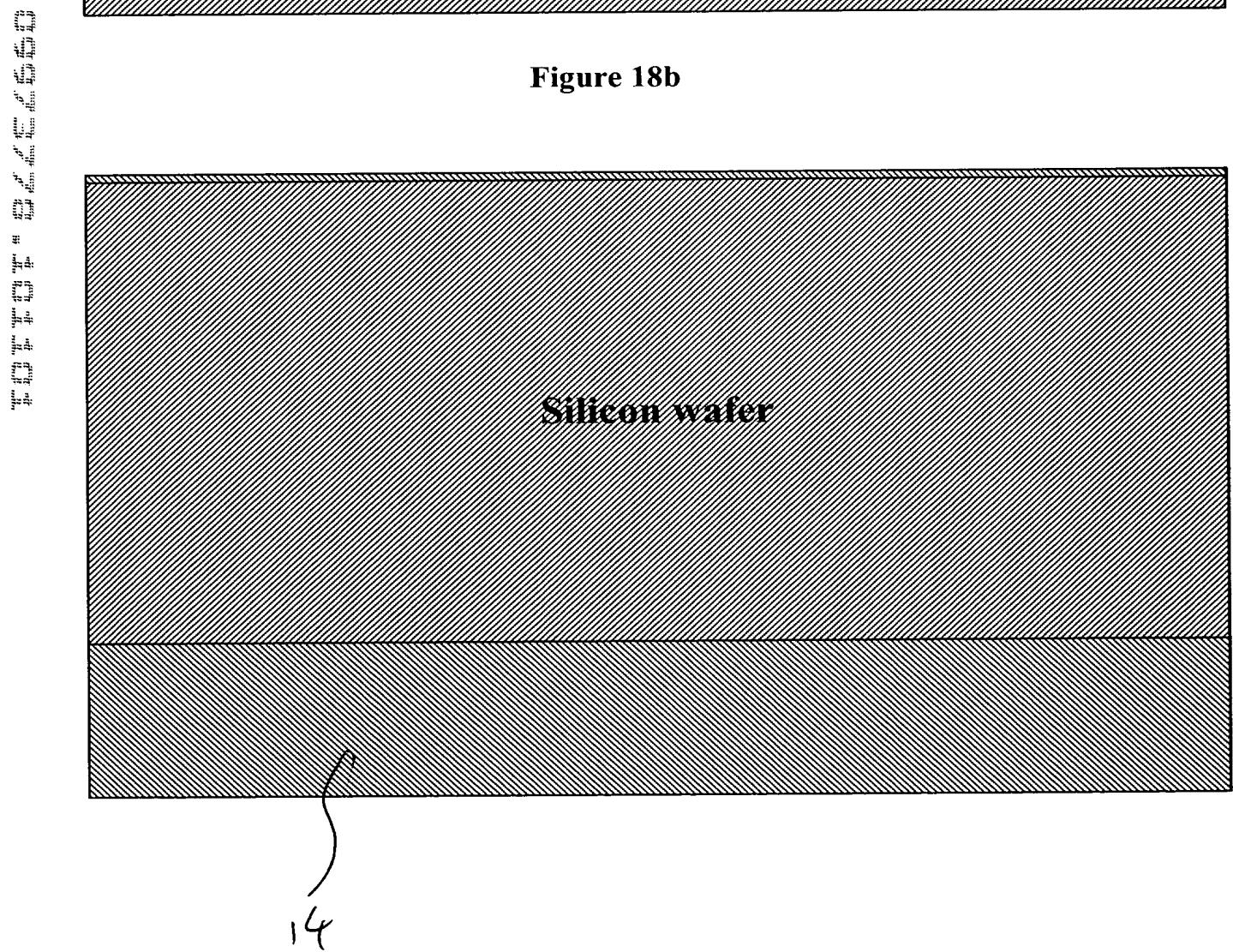


Figure 18c

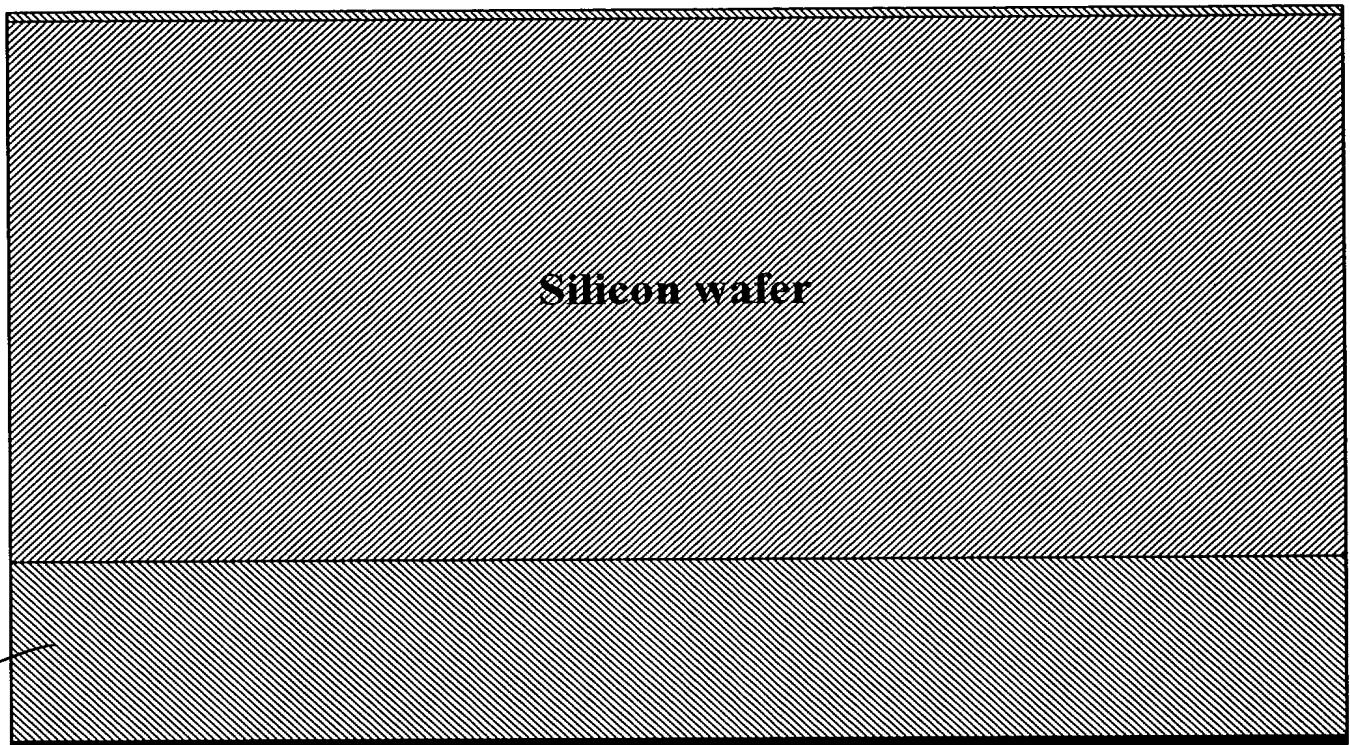


Figure 18d

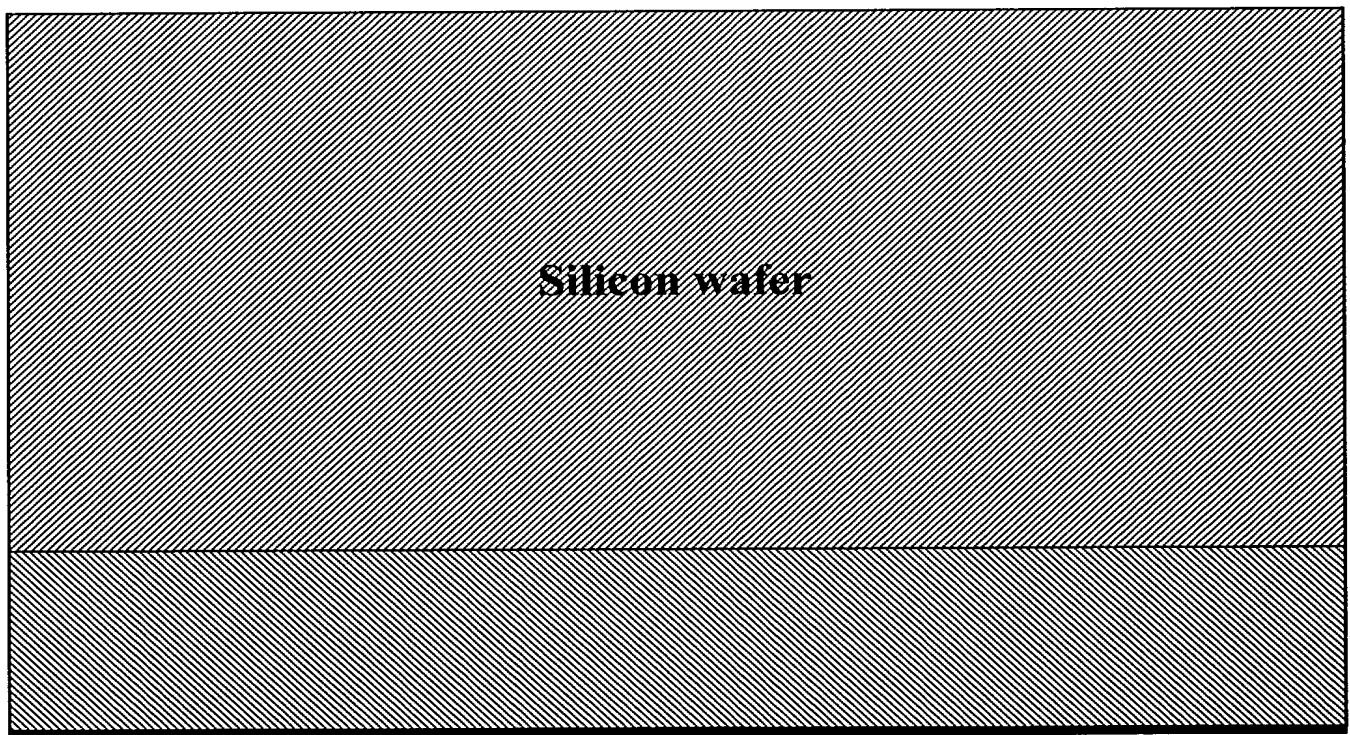


Figure 18e

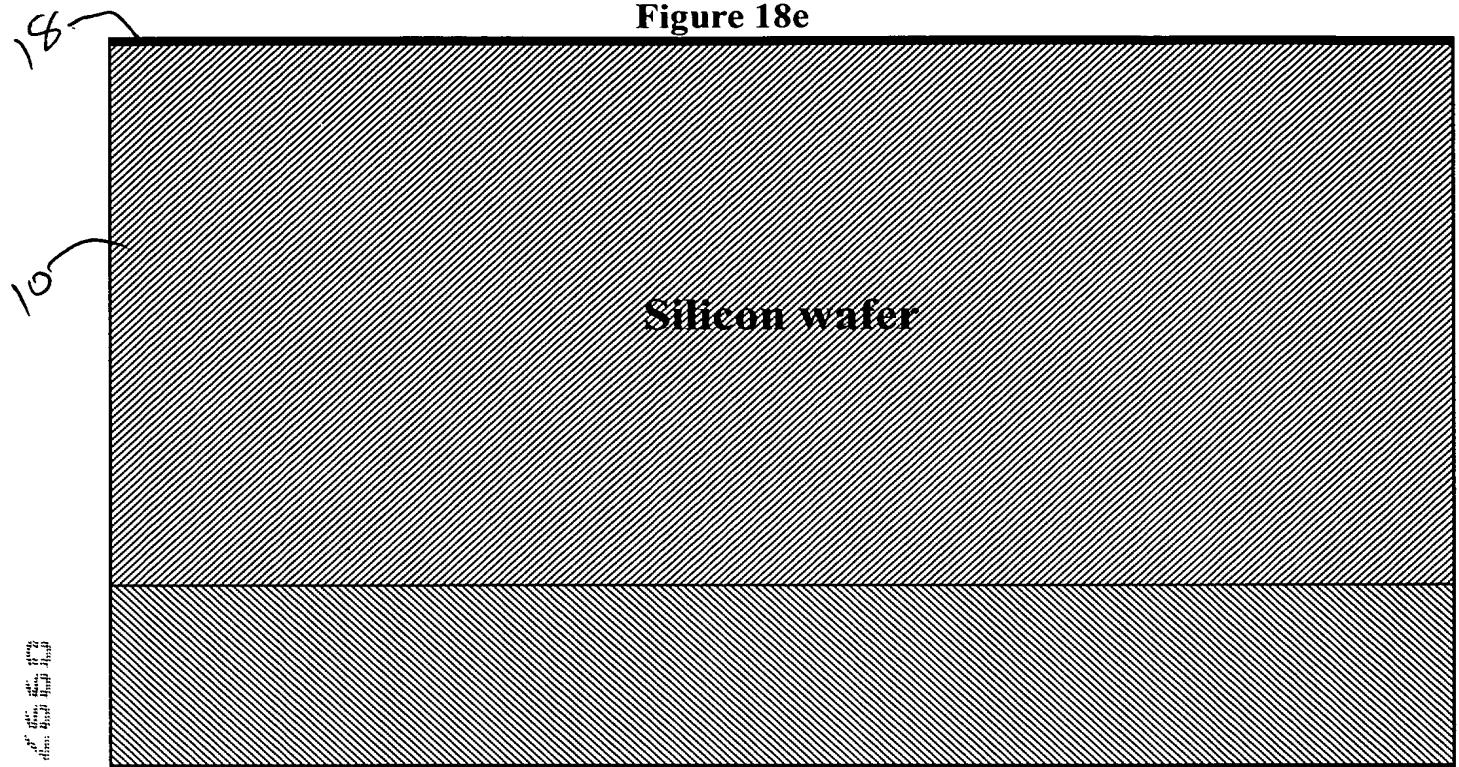


Figure 18f

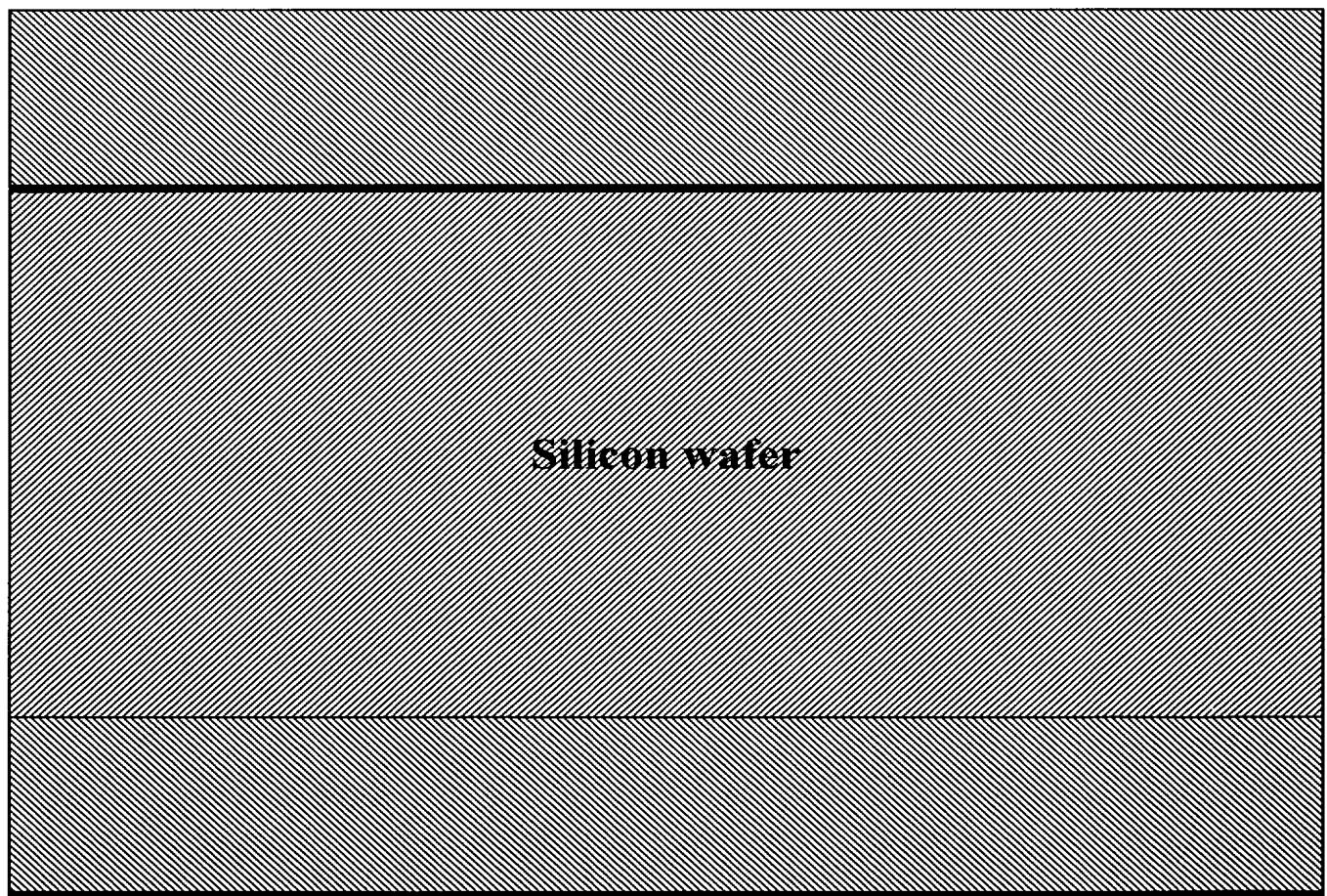


Figure 18g

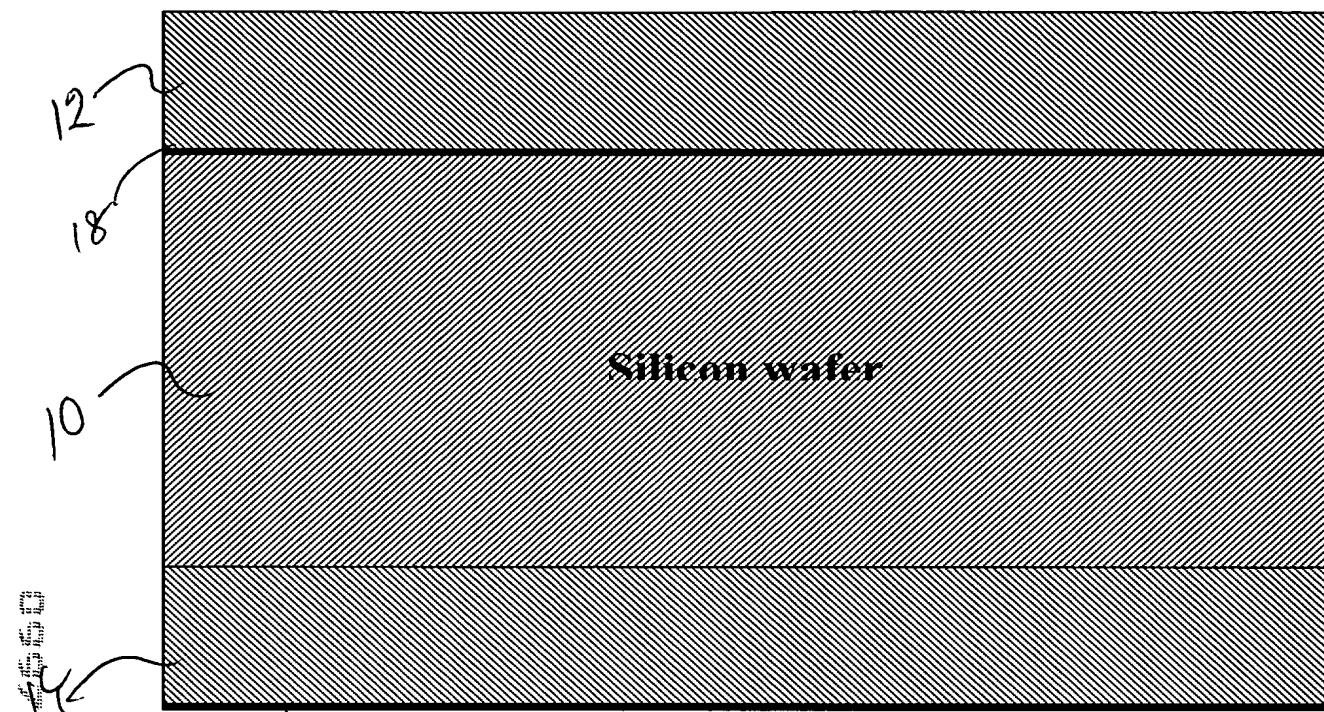


Figure 18h

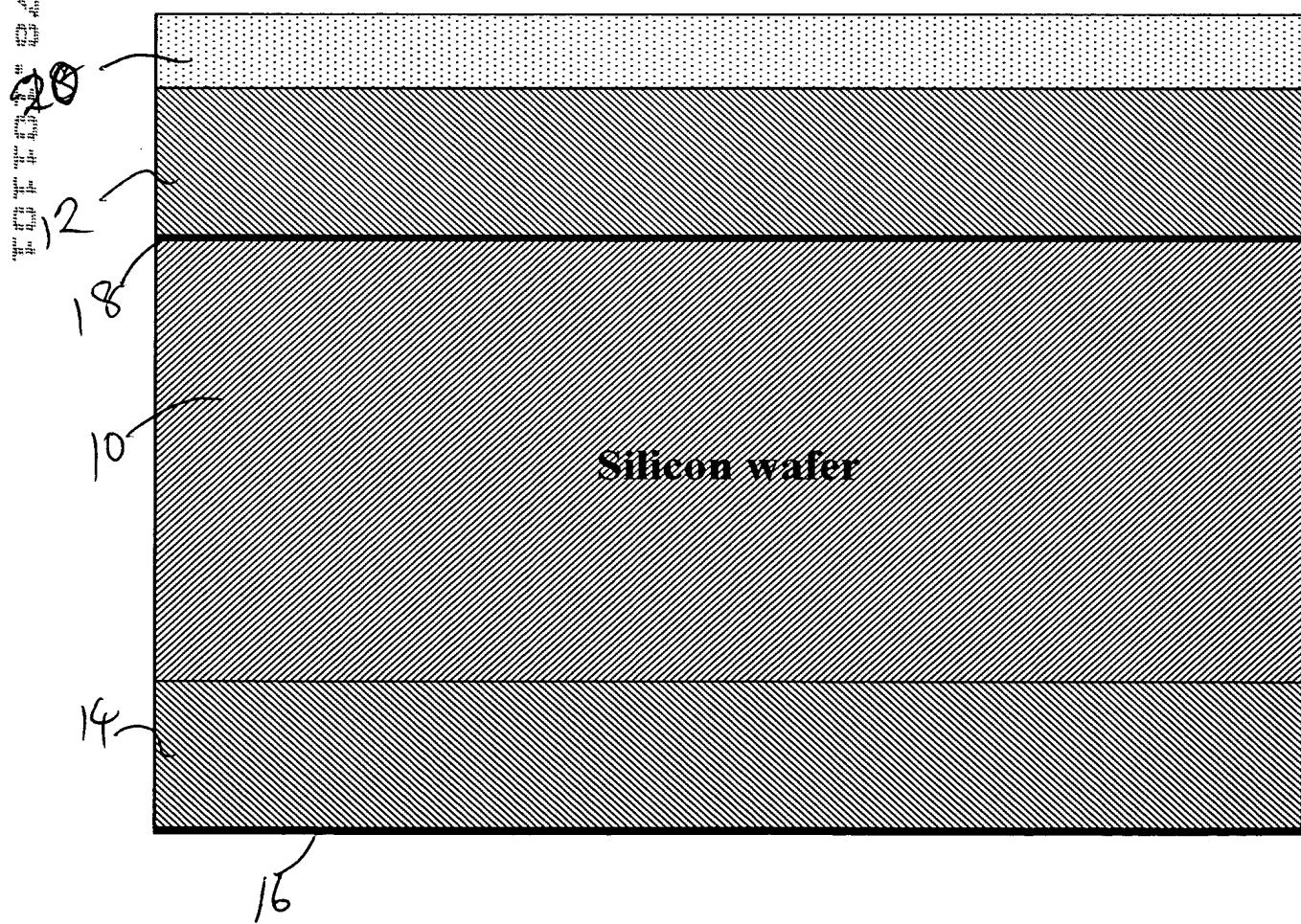


Figure 18i

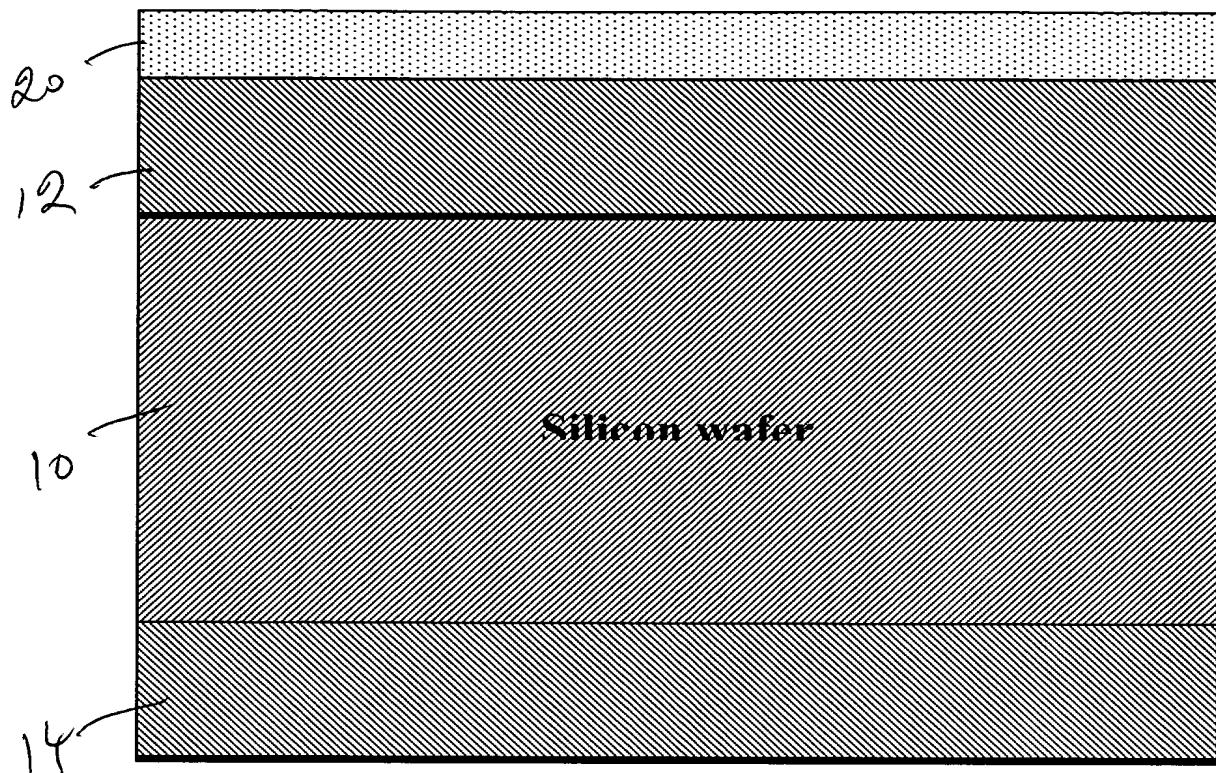


Figure 18j

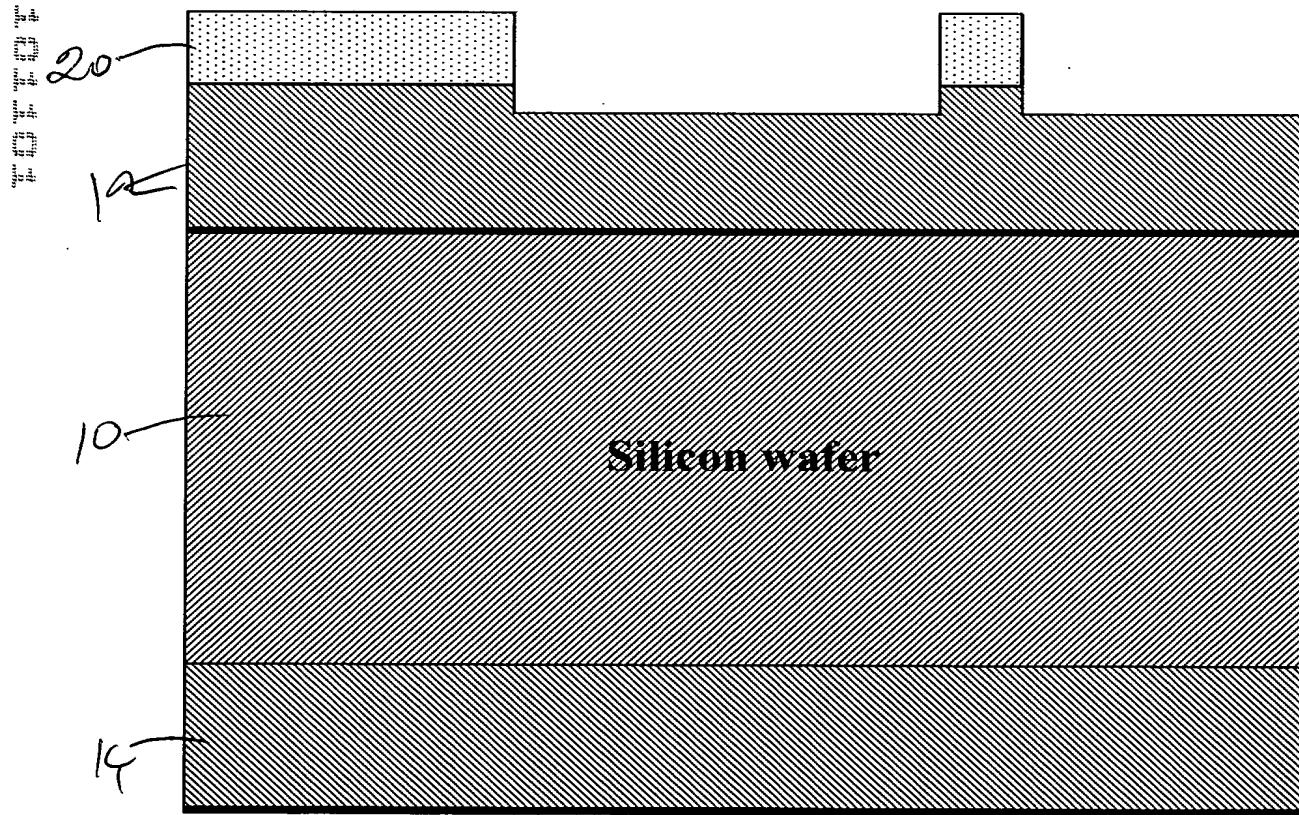


Figure 18k

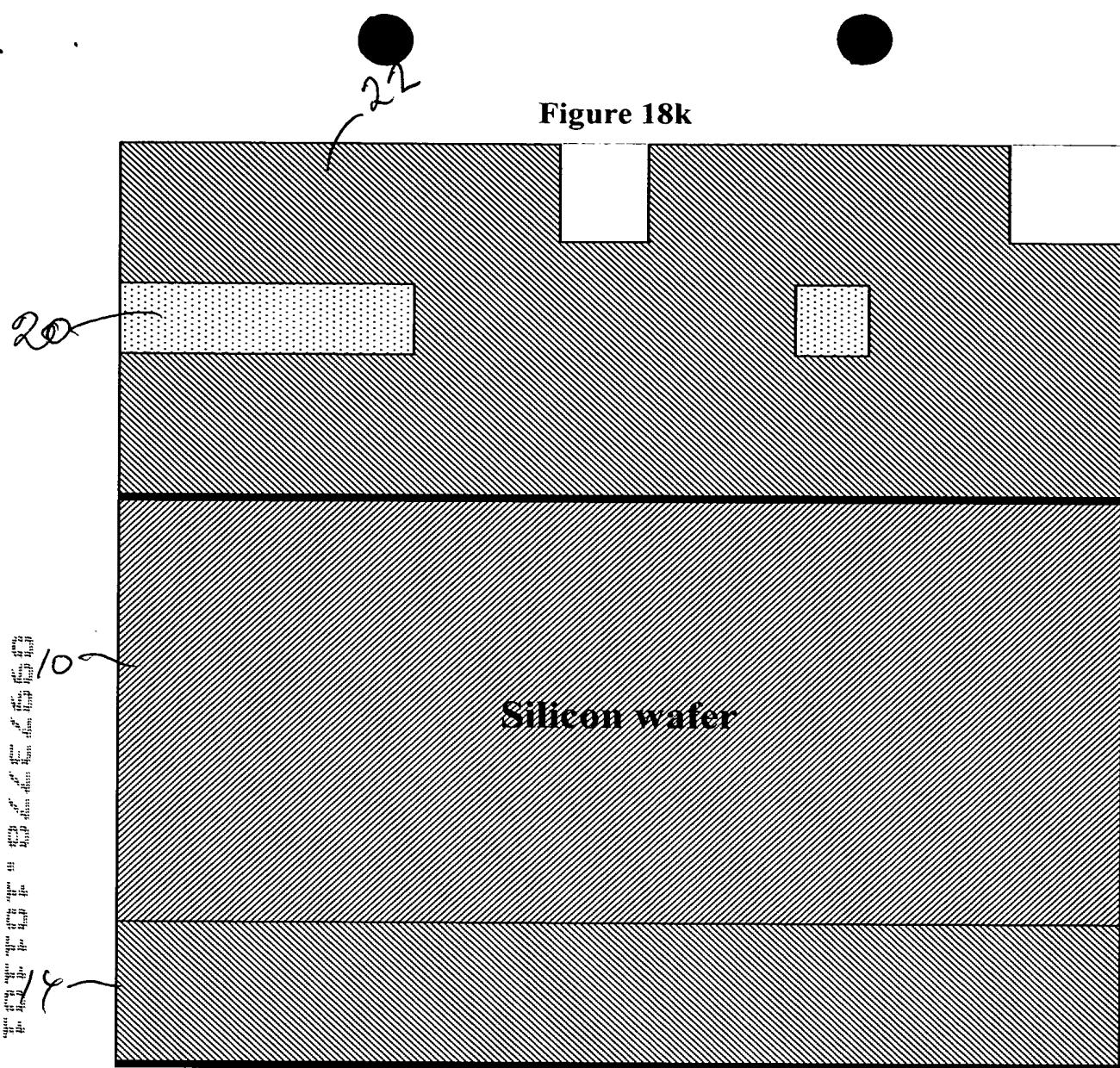


Figure 18l

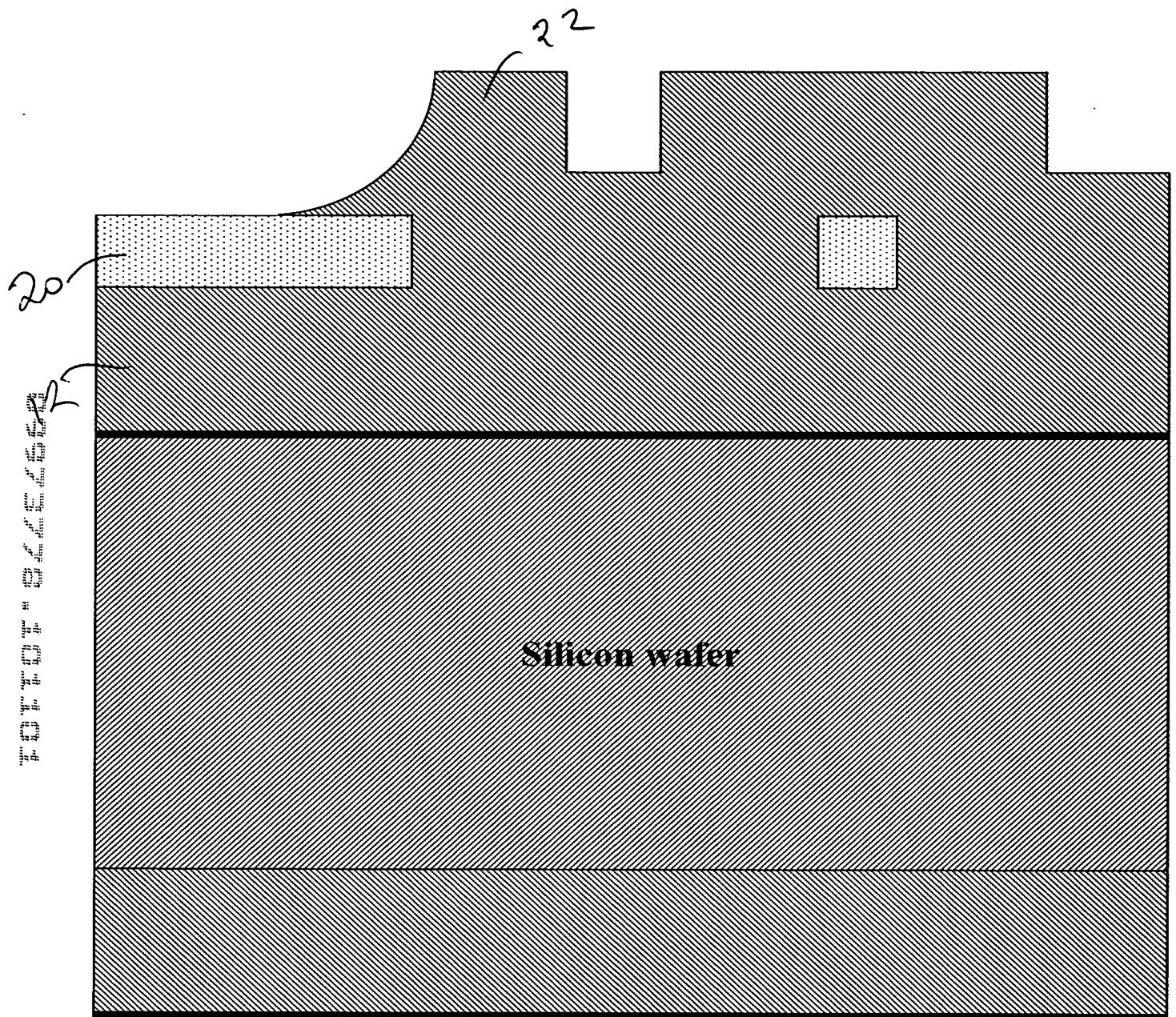


Figure 19

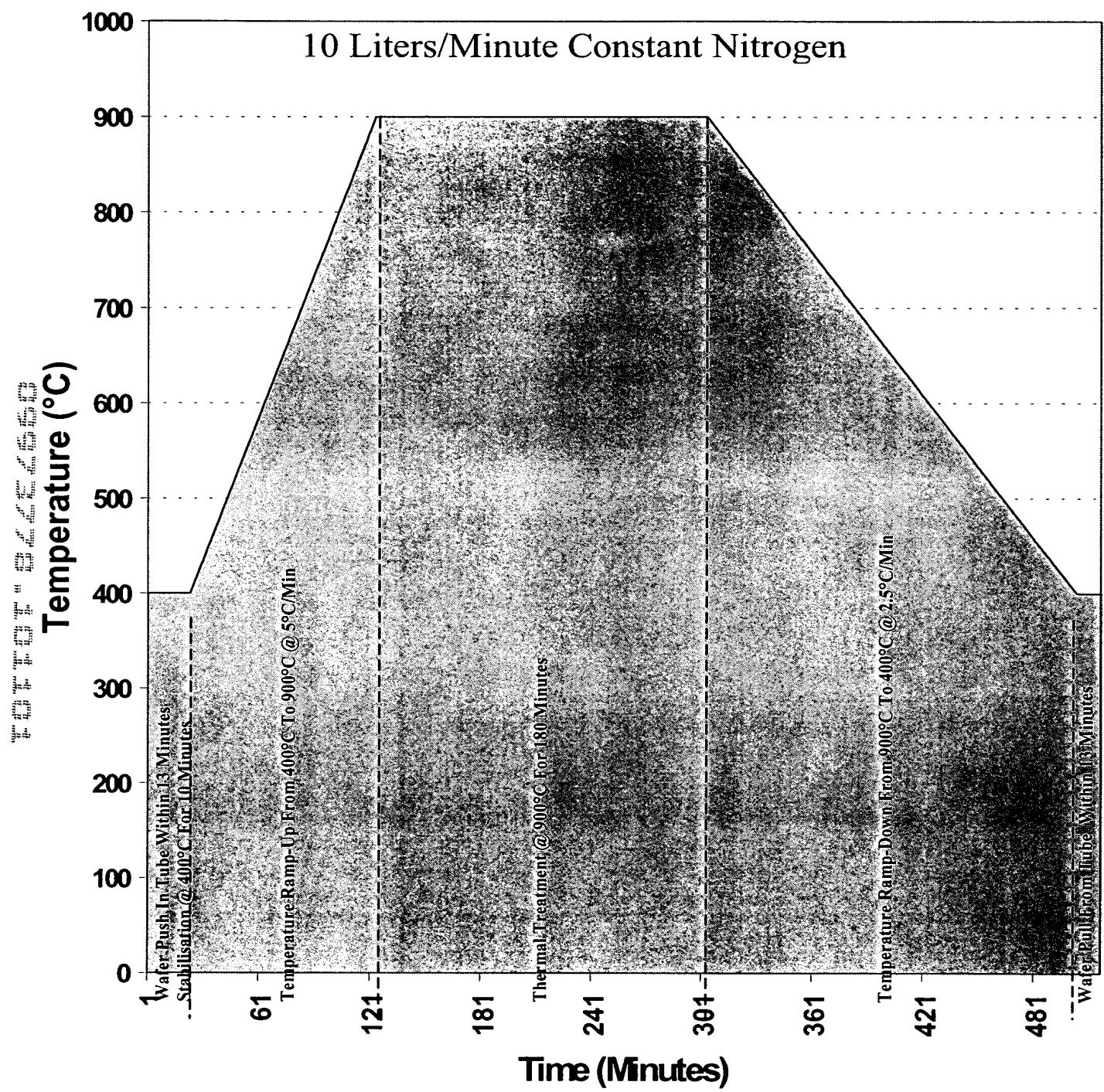


Figure 20

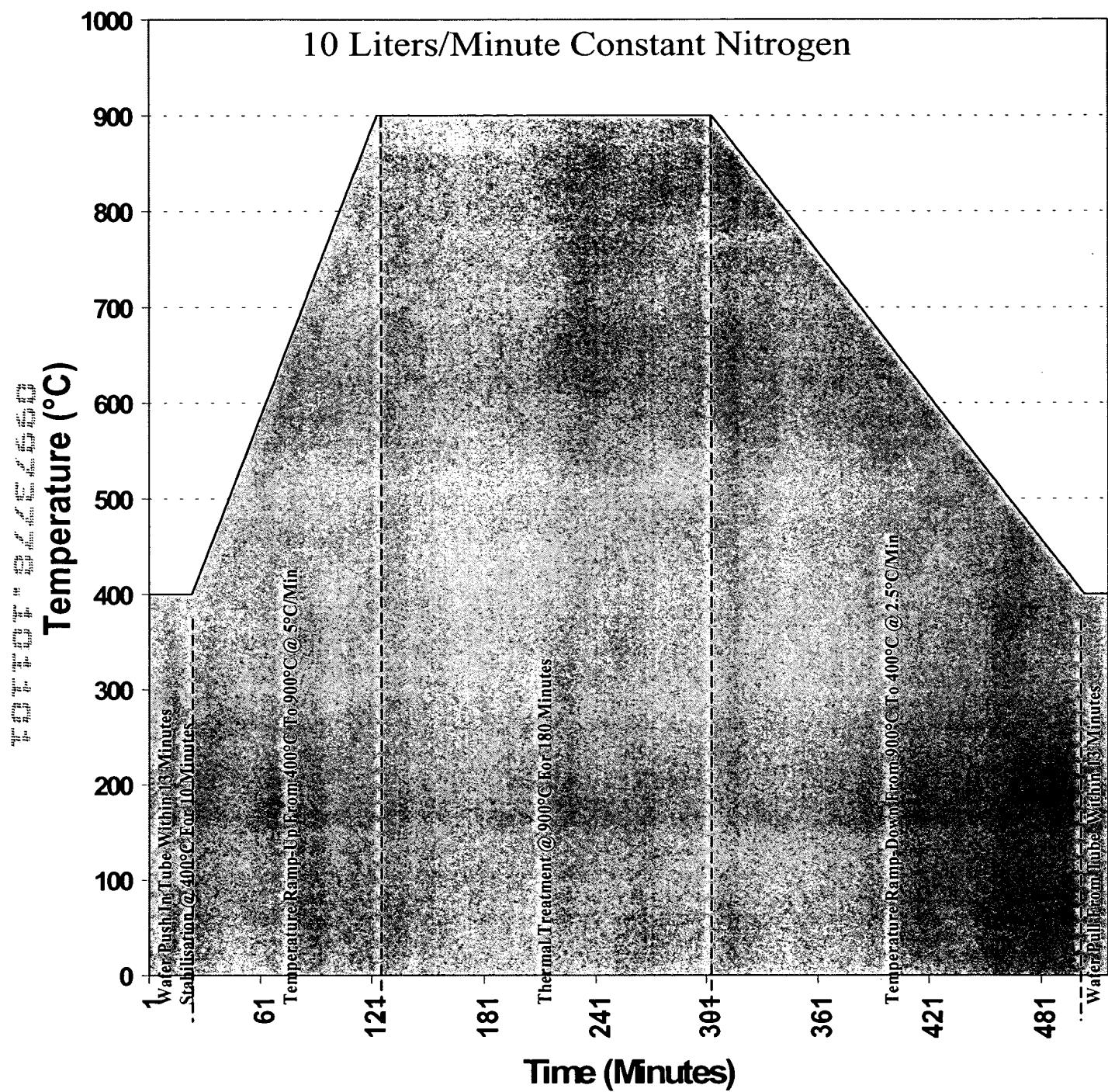


Figure 21

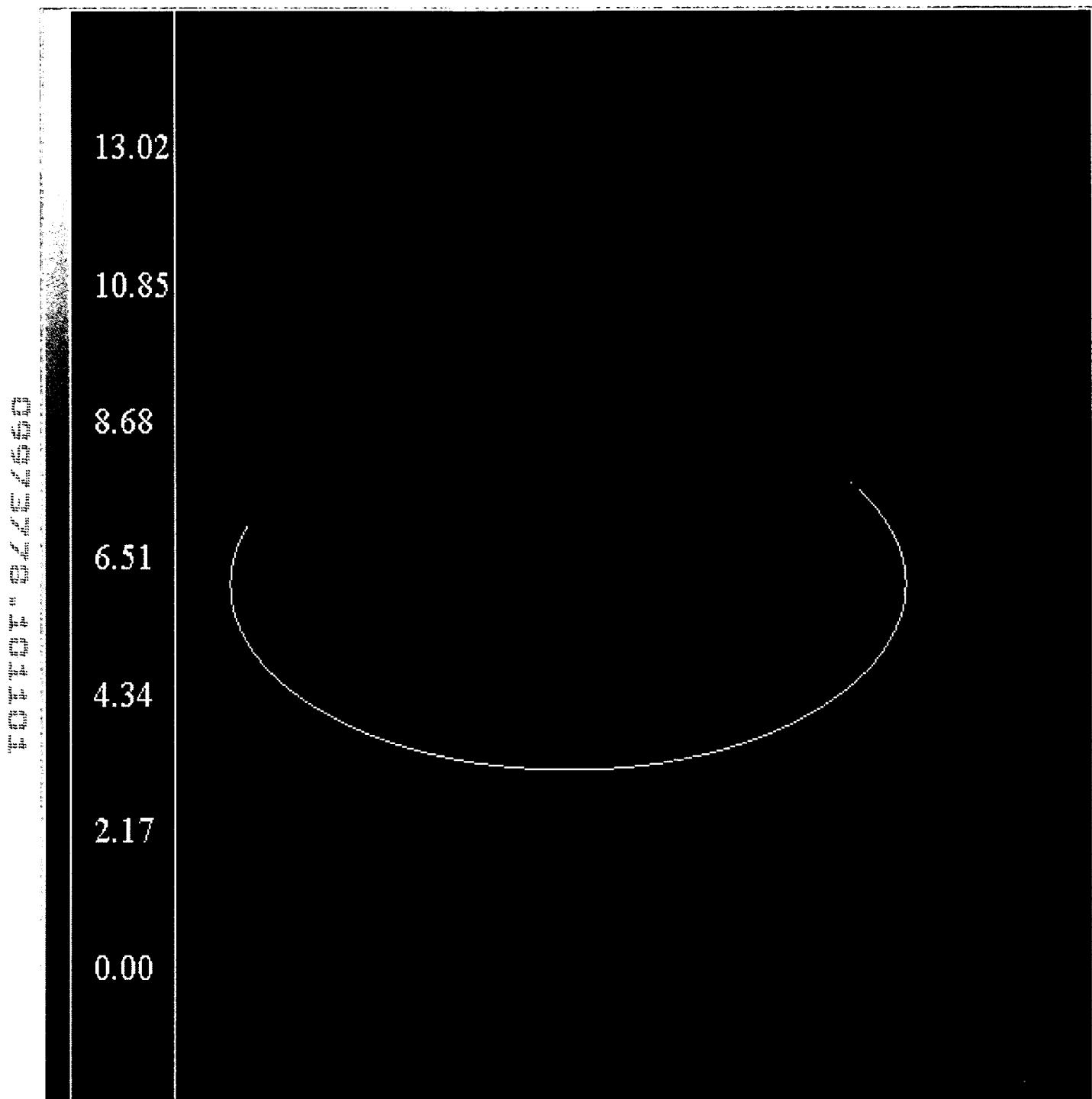


Figure 22

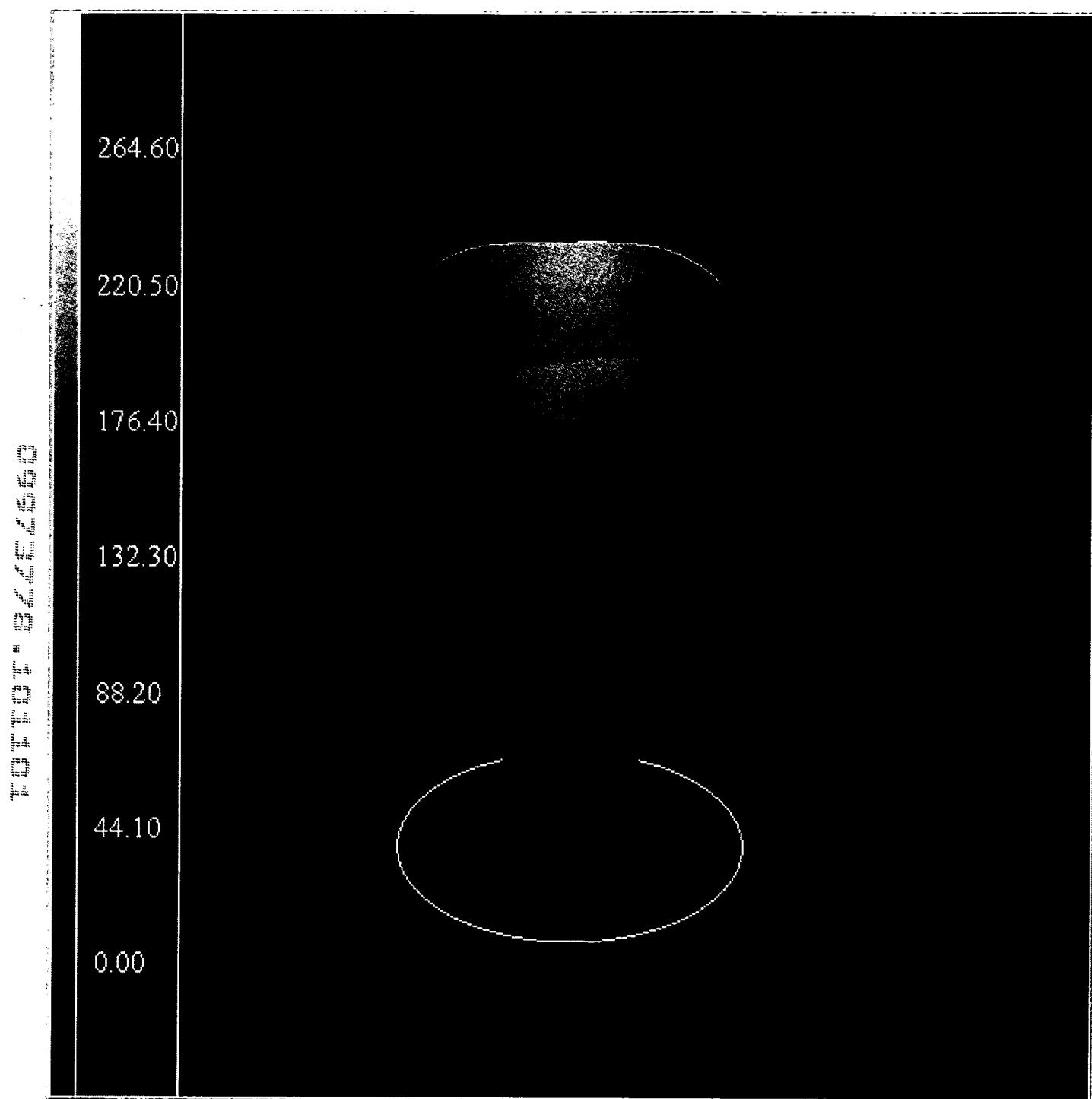


Figure 23

